► TABLE OF CONTENTS

Page

► INTRODUCTION 3

► 1.0 SUPPLY 3
- 1.1 Public 3
  - 1. 1. 1 Service Piping 3
- 1.2 Private 5
- 1.3 Main Water Shut Off Valve 8
- 1.4 Supply Piping in House 9
  - 1.4.1 Problems — Flow 11
  - 1.4.2 — Leaks 14
  - 1.4.3 — Freezing 14
  - 1.4.4 — Sweating 16
  - 1.4.5 — Noise Control 16
  - 1.4.6 — Location 17
  - 1.4.7 — Cross Connection 18
- 1.5 Isolating Valves 19
- 1.6 Water Heaters 20
- 1.7 Hot Water Circulating Systems 23
- 1.8 Inappropriate/Low Quality Materials 23

► 2.0 WASTE 24
- 2.1 Public 24
- 2.2 Private 24
- 2.3 Waste Piping in House 28
  - 2.3.1 Problems — Leaks 30
  - 2.3.2 — Slope 30
  - 2.3.3 — Freezing 30
  - 2.3.4 — Obstructions 30
- 2.4 Traps 31
- 2.5 Floor Drains 32
- 2.6 Venting 33
- 2.7 Solid Waste Pumps 35
- 2.8 Sump Pumps 36
- 2.9 Laundry Tub Pumps 38
- 2.10 Inappropriate/Low Quality Materials 39

► 3.0 FIXTURES 39
- 3.1 Sinks 39
- 3.2 Basins 40
- 3.3 Faucets 41
- 3.4 Toilets (water closets, commodes, hoppers) 41
- 3.5 Bathtubs 43
- 3.6 Bathtub Enclosures 44
- 3.7 Shower Stalls 45
- 3.8 Whirlpool Baths 46
- 3.9 Bidets 47
- 3.10 Saunas 47
- 3.11 Bathroom Fans 48
- 3.12 Kitchen Fans 48
- 3.13 Outdoor Faucets 49
- 3.14 Laundry Tubs 49

► 4.0 GAS PIPING 49

► INTRODUCTION

The purpose of a house plumbing system is twofold. On the supply side, the idea is to get water for drinking, washing and cooking to the appropriate areas of the house. The waste side of the plumbing system is intended to get rid of water and waste.

The supply water is under pressure and the waste water flows by gravity. Serviced communities provide the fresh supply water and carry away the waste. In rural properties, wells usually supply fresh water and septic systems handle the waste.

Since the beginning of the 20th century, plumbing systems have changed dramatically. There are now a myriad of fixtures and faucets available, and both supply and waste pipe materials have changed a great deal.

Plumbing components are expensive, and plumbing repairs or improvements are among the more costly projects homeowners undertake.

In a completed home, the majority of the piping, both supply and waste, is concealed within walls, ceilings and underground. Leakage, obstructions, or other problems may not be picked up during an inspection.

► 1.0 SUPPLY

1.1 Public Water Systems: Most homes in urban and suburban areas are provided with water by the town. Typically, the water mains in residential areas are 4 inches to 12 inches in diameter, and run several feet below the street level. Smaller pipes, usually 1/2 inch or 3/4 inch diameter, run from city mains into individual dwellings. The water is normally supplied at a pressure of 40 to 70 psi (pounds per square inch).

Problems

City water mains may be undersized or deteriorated in older neighborhoods, Some cities have poor pumping and/or distribution systems. In these cases, low water pressure problems are usually experienced at every home in the neighborhood. The only true solution is to petition the city to improve its system.

1.1.1 Service Piping: The service piping carries the water from the street mains to the house. It is common to find that very little or none of the service piping can be seen.

Typical Materials

Lead: Lead piping was used between the street main and the house up until the mid-point of the century. A good deal of lead supply line is still in use, and the health authorities indicate that as long as it is used regularly, there is no difficulty with it. If the water has not been run for some time, some recommend that the water be flowed for several minutes before using it.

Copper: Copper piping is used today for virtually all supply lines from the city main to the house. From 1950 to 1970, 1/2 inch and 3/4 inch diameter piping were used commonly. Since roughly 1970, most source piping is 3/4 inch diameter. Copper usually has an indefinite life expectancy. Some water contains chemicals which can deteriorate copper piping.

Galvanized Steel: Galvanized steel is not commonly used as a residential service pipe, although some galvanized steel fittings can be found at the point of entry into the house. In some areas, galvanized service piping is used. although authorities usually require at least 1-1/4 inch diameter pipe.

Plastic: Plastic has not been used commonly for city source piping, although plastic piping is commonly used between a well, lake or cistern and a house. The performance of these pipe systems has been good, although it has only been used extensively since the 1960's.

Problems

Leaks

The underground water supply line from the property line into the house, is owned by the homeowner. Beyond the property line, the pipe is the responsibility of the city. A leak in the pipe requires excavation, and it is often difficult to know until one begins to dig, whether the leak is on the city's or the homeowner's side. The city is usually contacted and they excavate their section of the pipe, correcting the problem if they discover it. If no problem is found, the homeowner is left to correct the problem on his or her own. In some cases, the homeowner must pay for the city's work if the city pipe is not at fault.

Since the supply line from the street cannot be seen, no comment can be offered during a visual inspection. If there is a leak, it may go undetected for some time. The water meter inside the building is downstream of any leak in this pipe and thus, will not show the problem. In some cases, water can be heard running outside the basement wall. Water accumulating in the basement, or a wet spot on the lawn are often the first indications. Leaks may be caused by building settlement, excavation, poor connections, faulty valves or a flaw in the pipe itself.

Low Pressure

The more common problem with the supply piping from the street is poor water pressure in the house. This may be the result of a partially closed or obstructed valve in the street. It may also be because of blockage, such as a stone in the pipe. It is not unusual for fairly large foreign objects to get into supply plumbing systems. Normally they cause no problems, but occasionally they become lodged in shut-off valves and water meters, for example.

Pressure Regulators

Where municipal water pressure is above 80 psi, a regulator should be provided to prevent leaks at fixtures, stress on appliance hoses and possible broken pipe joints.

Small

In most new housing, the supply pipe from the street to the house is 3/4 inch diameter. In older houses, the piping was as small as 3/8 inch.

Modern life styles and additional plumbing fixtures usually require a larger line, capable of providing more water. Replacing this pipe is an expensive and disruptive job. It is often deferred as long as possible.

Crimped — With new piping, it is possible for the pipe to be crimped during installation or to be pinched under a rock, for example, during back-filling operations.

Freezing — It is unusual, although not impossible, for the supply line to be too close to the surface, and to freeze during very cold weather.

Lead — Up until World War II, most of the supply pipes in built-up areas were lead. While these generally provide good service, they do tend to be smaller and may have to be replaced. Also, lead is relatively soft, and if building settlement occurs, there is a chance of leakage or crimping the pipe. Leaks can also occur at older connections as a result of long term deterioration.

Shared — In some semi-detached (attached) and row houses built around the turn of the century, a single supply line would run under a front lawn, and then split to feed two houses. This often yields unsatisfactory water pressure for both houses and has to be replaced with two larger, separate lines.

Steel — Many of the old lead supply lines were connected to a galvanized nipple or short piece of steel pipe which contacted the soil. This pipe will corrode on the exterior as well as rust on the inside, and it may be susceptible to leakage or rupture in an older home. It is often wise to replace this as a precautionary measure. Galvanized steel service pipes can be expected to last roughly forty years. They are replaced with copper when pressure or leakage problems develop.

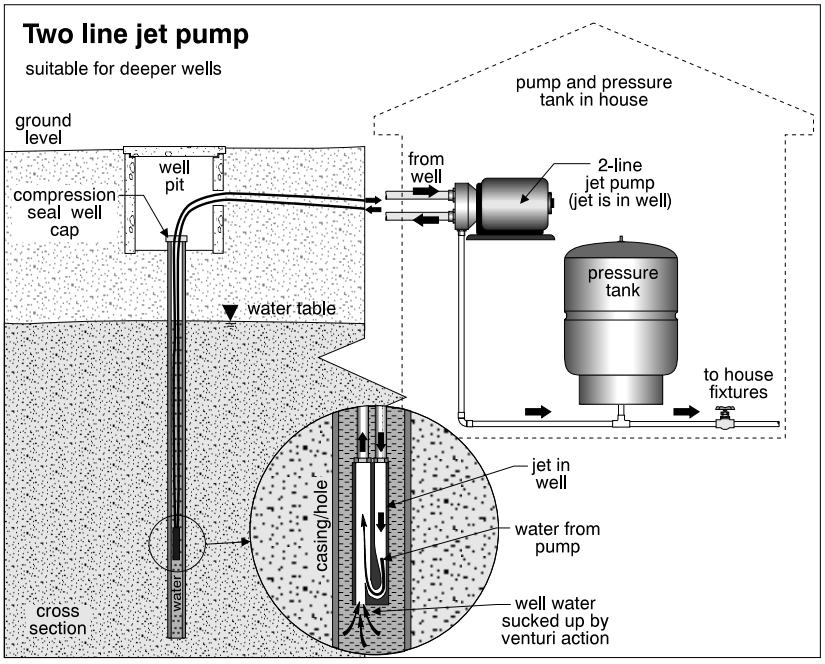
Under Basement Floor — Some older houses have supply lines that run under the basement floor, coming up into the basement near the middle of the house. In some cases, the water supply lines enter the basement in more than one spot. When problems (leakage or low pressure) are experienced, these under-floor lines are usually abandoned. The new pipe is connected to the supply line from the street at the front of the basement. The supply line is then run along the basement ceiling to the various take-offs.

Well — **1.2 Private:** Where a city water supply is not available, water must be provided by the homeowner. Typically, this is done by a well. Wells may be shallow (twenty-five feet or less) or deep (more than twenty-five feet).

Service Piping — The service piping is most often plastic and the comments in Section 1.1.1 are appropriate.

Pump — A pump is needed to move the water from the source into the house piping system. The pump may be located at the bottom of the well, at the top of the well, or in the home.

Reciprocating or piston type lift pumps were often used on older systems, while centrifugal pumps are used more typically in modern installations. Shallow wells may use reciprocating or centrifugal pumps. Deep well pumps are most often centrifugal, either jet type or submersible.



A surface pump may be located in the basement of the house, or at the top of the well in a pump house. Pump houses are not common in buildings used year round, because the pump has to be protected from freezing in winter.

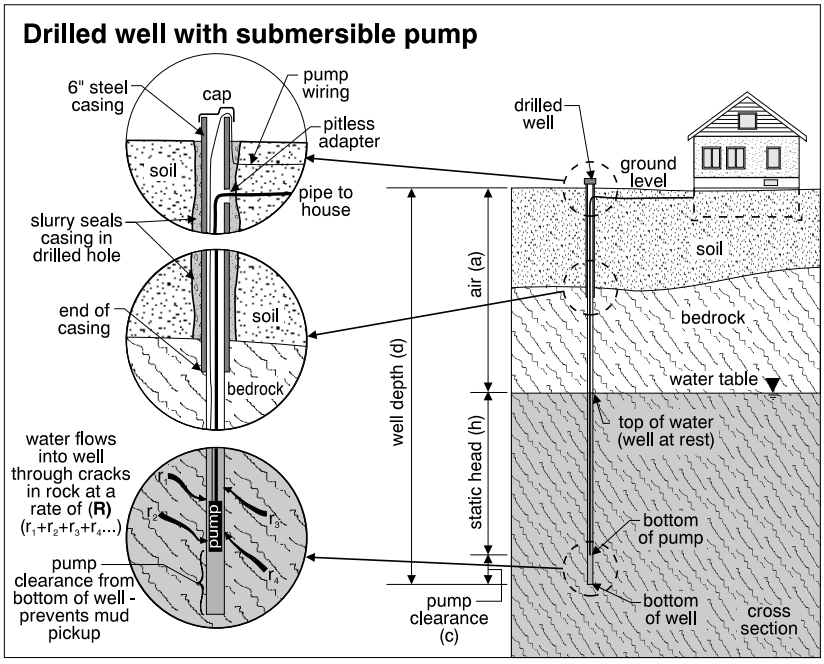
Well water should be tested on a regular basis, as recommended by the local health authorities. Typically, this involves sending a sample to the authority for testing. Many authorities provide test canisters.

Well draw-down tests can also be done by plumbers. This is a test of the pumping capacity of the well. The test is usually done over a period of hours and gives an indication of the water volume available. This may vary from season to season as the water table changes.

Pressure Tank

Where a pump is used, there is also a storage or pressure tank, typically located in the basement. This tank gets around the problem of having the pump come on the instant a faucet is opened in the home. This tank may be only a gallon or two, or it may be several gallons. The tank provides relatively even water pressure to the house.

Since water is incompressible, a portion of the tank should be filled with air. The air is easily compressed, and when there is a demand for water, the air pressure in the tank forces the water out. The tank pressure slowly reduces as the water leaves and the air expands. When the pressure gets to the lower setting of the pressure switch, the pump is activated, forcing more water into the tank and compressing the air again. As the air is compressed, the pressure builds up until the high limit switch is tripped, and the pump shuts off. The air above the water acts as a spring. Typical low and high limit settings for a pump are 25 psi and 50 psi.



Waterlogged

Over time, the air in the tank will be absorbed into the water and the tank will become "waterlogged". This means that the tank is full or nearly full of water. Use of water in the house will often cause the pump to come on and off very quickly. This short cycling is very hard on the pump, and the system should be serviced promptly. It is not difficult to add air to the tank to correct the situation. Some tanks are provided with a diaphragm to separate the air and water, preventing the air from being dissolved into the water.

Lakes, Rivers & Cisterns

Private water sources may also include lakes, rivers or cisterns (large holding tanks). Cisterns may be filled by rain water or delivered water from a truck. Typically, pumping arrangements similar to wells are employed, and the water quality should be tested in the same fashion.

Pump

Problems

Problems with a supply pump include the following:

a) No power to the pump (switch shut off, fuse blown, poor electrical connection, etc.). If the problem is not obvious, an electrician should be called.

b) Pump does not work. (Pump seized or frozen, motor burned out, faulty pressure switch, bearings shot, etc.)

c) Pump short-cycles or runs continuously (foot valve leaking, pressure tank waterlogged, leak in piping system, pump has lost its prime, faulty pressure switch).

d) Excessive noise or vibration (poor alignment, worn bearings, etc.).

e) Water is dirty. The well may be running dry. A well draw-down test may be recommended by a plumber. Alternatives are to reduce water use (stop watering the lawn, for example) or improve the water supply.

f) Leak at pump or piping.

g) Pump operating, but pressure is poor. (Partially closed valve, obstructed pipe, leak in system, poor adjustment of pressure switches).

Most of these problems require a plumber.

Tank

The pressure tank is susceptible to corrosion and/or leakage. These tanks are subject to considerable condensation during the summer months, in particular. This condensation on the outside of the tank can ultimately corrode the tank. Ideally, the tanks should be insulated to minimize condensation, although very few are. A corroded tank is replaced when it begins to leak. A leak caused by a poor connection is easily repaired.

The tank is waterlogged (there is no air cushion in the tank) if, when the water is flowed, the pressure gauge drops to the cut-in point of the pump and then rises quickly to the cut-off point several times a minute. This is not a serious problem. The air cushion in the tank has to be restored. Some tanks have an air supply valve attached to them so that air can be pumped into the tank. Tanks with diaphragms should, in theory, never lose their air cushion. Eventually, of course, the diaphragms do fail.

1.3 Main Shut-off Valve: The main shut-off valve should be located and tagged. This valve allows one to shut off all the house water at one location. The valve should be readily accessible, and it should be verified that it is operable. Since these valves are operated infrequently, it is not unusual for them to become stuck over time. They often leak when operated after a period of inactivity. For this reason, they are not tested during a home inspection.

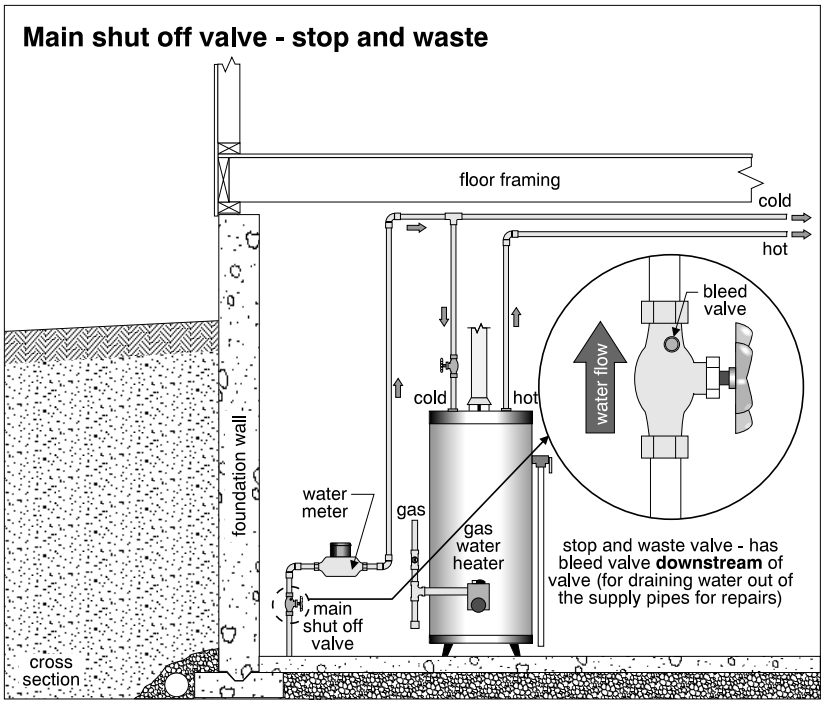
Some main shut-off valves have bleed valves on them. These small auxiliary valves allow the water downstream of the shut-off valve to drain out of the system once the valve is closed. Some of these bleed valves can be shut off, although others discharge automatically, as the main valve is closed. This discharge of water can be disconcerting if one is not familiar with the bleed valve function. If the water which drains out of the pipe can do damage, a container should be provided under the valve while it is draining.

The valve cannot always be located during a home inspection, due to storage and/or finishes. Where this happens, the homeowner should locate the valve when the house is vacant. In mild climates the valve may be outside the house. In freezing climates, the valve should be in a heated area.

Problems

Missing, Damaged, Leaking

Where there is no main shut-off valve, one should be added near the point of entry into the house. Where the valve is damaged or inoperative, it should be repaired or replaced as necessary. Similarly, a leaking valve should be repaired promptly. This means shutting off the water at the street.



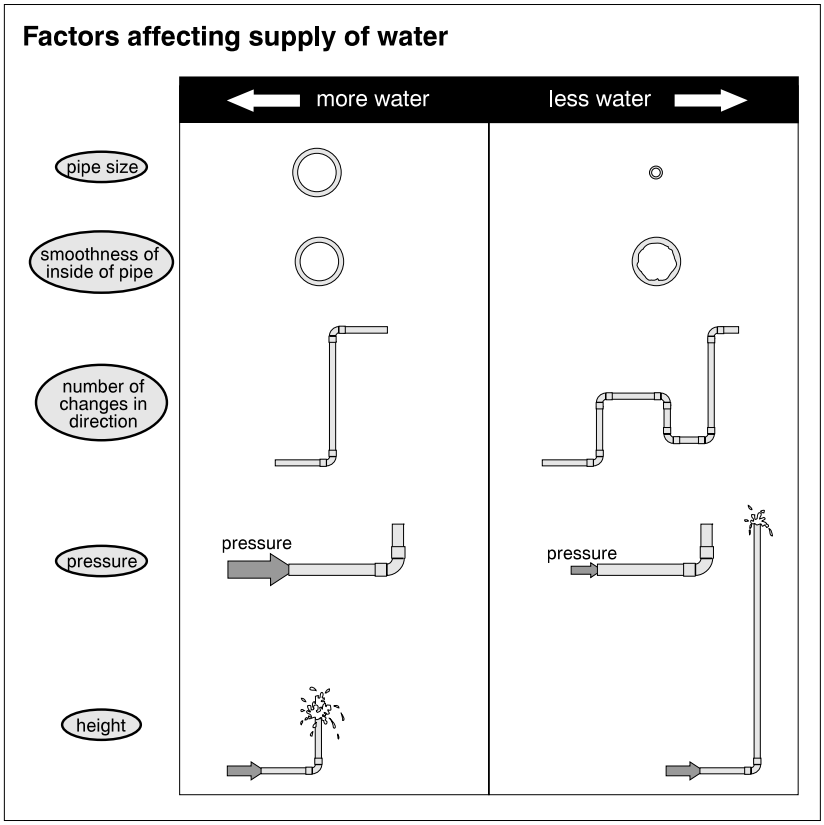
Partly Closed

Poor house water pressure is occasionally the result of partially closed main valves. This, of course, is easily corrected.

1.4 Supply Piping in House: A relatively small section of the supply piping can be seen during a typical home inspection. No comment can be offered on concealed plumbing.

Typical Materials

Galvanized Steel: Galvanized steel piping was used, almost exclusively, up to approximately 1950. Depending on the pipe diameter, the water composition, and the amount of use, this piping typically lasts forty to sixty years. Some lower quality pipes do not last as long, and there are some oversized pipes still in use after sixty years.



Galvanized steel pipes in a house are typically 1/2 inch inside diameter. The connections are threaded. When the pipe wears out, the rust accumulation inside the pipe chokes down the diameter of the pipe, resulting in poor water pressure. Eventually, the pipe will rust through, usually at the joints first, resulting in leakage.

Rust

As rust builds up inside the pipe, a brownish water color is often noted when a faucet is turned on, especially after several days of inactivity. This is rust accumulation which, after flowing water for several seconds, will disappear in all but the most severe cases.

Copper: Copper pipes have been in use residentially since approximately 1950. Since the mid 1950's, copper has been virtually the only material used. In the 1970's, plastic supply piping was approved, although it is still not commonly used.

Life Expectancy

Copper piping is typically 1/2 or 3/4 inch diameter. As far as we know, copper piping will last indefinitely, unless unusual water conditions (high corrosive mineral content) or manufacturing defects are present.

Types

Copper piping has soldered connections and the walls of the pipe are thinner than galvanized steel. (Note: In many areas, solder is now required to be lead free.) There are three types of copper piping used. Type M has the thinnest walls and is not used commonly by plumbers. Type L is the most common and is a medium wall thickness. Type K is the thickest, often used in underground service piping. It usually cannot be determined during a visual inspection which type of pipe has been used. This is not an issue in most residential situations.

Flexible

Flexible copper piping is available which can be bent around corners using special tools. This is not common since it is more expensive and can be awkward to work with in close quarters. It is often seen in amateurish installations.

Plastic: Plastic supply piping is most popularly used by the do-it-yourselfer. Connections can be made without soldering, and the pipe is easy to work with. There are two common types, polybutylene and CPVC.

Polybutylene (PB)

Polybutylene pipe uses press-on fittings and care must be taken that the pipe does not contact heating ducts. If the pipe freezes, it is less likely to burst than copper piping and the pipe can be bent by hand on a seven inch radius. The pipe tends to sag and should be well supported by hangers.

Polybutylene piping has been the source of some plumbing problems, including failed fittings, possibly resulting from faulty installation. PB piping was removed from the Uniform Plumbing Code in the U.S.A. in 1989, as an approved water distribution material. In some cases, the piping manufacturer will inspect, repair or replace the PB piping at no cost to the home owner.

CPVC

Chlorinated poly vinyl chloride (CPVC) pipe is not as flexible as polybutylene and the fittings are solvent welded (glued) rather than press-on. This pipe is likely to split if freezing occurs. Again, a good number of hangers should be provided.

Most plumbers prefer to work with copper and, although the plastic pipe is less expensive than copper, the fittings are expensive. Some codes do not allow plastic pipes, and there are several other types of plastic. Some are only suitable for waste, underground or cold water piping.

Brass: Brass piping has never been used extensively. It was used in the early 20th century in high quality homes and areas where water quality was such that steel piping may have been attacked. Brass piping is an alloy of copper and tin which can be identified by its threaded fittings and inability to attract a magnet.

Two different brass alloys were commonly used, one known as red brass and the other as yellow brass. The yellow brass lasted only 20 to 40 years, while the red brass can last 50 to 60 years. In either case, it is generally recommended that brass supply piping be closely monitored as it is likely to be near the end of its life. Brass piping becomes brittle toward the end of its life and may be subject to serious leakage problems. Generally speaking, brass is replaced with copper piping today.

City

1.4.1 Problems-Flow (Pressure): Water flow (in gallons per minute) is a function of several things, including the size and shape of the opening, and the pressure at the opening. The pressure available from the source (city or private pump) has an impact on water flow, of course. Typically, city water supplies are at 40 to 70 psi (static pressure).

Well

Most older private systems are set to maintain water pressure between 20 psi and 40 psi. This is too low for some lifestyles and plumbers can set systems higher, in some cases. This is only successful, of course, if the pump is capable of delivering higher pressure.

Pressure vs Flow

Static pressure is the pressure exerted by the water against the walls of the pipe with no water flowing. A horizontal pipe one hundred feet long connected to a huge reservoir with a constant pressure of 60 psi, will have a pressure of 60 psi anywhere along the pipe, if the valve at the other end is shut. As the valve is opened and water begins to flow, the pressure drops as water moves along the pipe. This is a result of friction loss along the pipe walls. If gages were put on the pipe every ten feet, the gage at the reservoir would still read 60 psi, and (depending on the pipe diameter and the amount of water flowing), the gage ten feet from the reservoir might read 58 psi; the gage twenty feet down would read 56 psi, and the next gage 54 psi, et cetera. At the end of the pipe, the pressure might be 40 psi. (This is a simplification of the process, and is not entirely accurate.)

As more water is flowed, the pressure would drop more at each point along the pipe. The water pressure at the reservoir would always be 60 psi. The reservoir is roughly equivalent to the city water main under the street. The amount of pressure lost as water flows through a pipe is largely a function of the pipe diameter and the amount of water flowing.

Improvement

The more plumbing fixtures flowing at once, the greater the pressure drop at all fixtures, and the lower the flow at each fixture. If we replace any ten foot section of pipe with a much larger pipe, the pressure drop across that section will essentially be eliminated. Replacing any section of pipe will result in somewhat better pressure (and flow), at the valve. This is very surprising to many people, who think that the most upstream section of pipe, or the entire pipe, must be changed in order to enjoy any benefit. The "bottleneck" principle does not apply in an absolute sense to plumbing systems. Water flow in a house can be improved to some extent by changing any pipe in the system.

Gravity

Gravity is another source of pressure loss in a residential plumbing system. Energy is required to push the water uphill. For every one foot of elevation increase in a pipe, approximately 0.434 psi is lost. Another way of saying this, is that it takes 1 psi to move water 2.31 feet higher. A house system will typically lose eight psi in a two story house, getting the water from the basement up to the second floor bathroom. With no water flowing, the static pressure available at the street main may be 60 psi, but the static pressure at the second floor basin would be 52 psi. Houses which are much higher than the street, or have third story plumbing fixtures, will suffer a pressure disadvantage.

Galvanized Steel

Where the water pressure is poor in the distribution system, the most common cause is corroded galvanized steel piping. The common 1/2 inch diameter piping can close down so that the opening is only 1/8 inch in diameter or even less. The only solution is to replace this pipe, typically with copper. The diameter of the new pipe should never be smaller than the original piping. It is often wise to replace with a larger diameter pipe on the main feeds at least, to improve pressure further. A 3/4 inch pipe is recommended from the point of entry into the house to the water heater, at least. On large or multi-family dwellings, this should be larger.

Partial Replacement

When galvanized steel pipe is present, and pressure is low, it is common for the readily accessible pipes running across the basement ceiling to be replaced first. While there will also be some deterioration in the risers going up to the plumbing fixtures, the horizontal pipes tend to deteriorate slightly more quickly. The accessibility of the horizontal pipes in the basement makes it less expensive to replace these. Changing the basement pipes will help in the short term, but eventually the risers have to be done as well.

Replacing Hot Only

Another practice which is common, but is very short sighted, is to replace the hot water piping and not the cold. The hot water pipe pressure deteriorates somewhat sooner than does the cold. This is because the rust build-up on the inside of galvanized steel piping is the result of a chemical reaction (oxidization). Reactions such as this proceed more quickly with higher temperatures. Thus, the hot water piping deteriorates a few years before the cold.

When replacing pipes in a house, the labor is the major cost. When changing concealed pipes, a large part of the labor cost is breaking out the walls and ceilings to get at the pipes, and repairing and redecorating afterwards. It is expensive to break out and replace walls and ceilings twice within a five year period, the first time to change the hot pipes and the second to change the cold.

Lead Waste

It is also wise to replace any lead waste plumbing found at fixtures when replacing galvanized steel supply plumbing. The lead waste plumbing, although it may look fine, can be expected to leak soon in a bathroom old enough to have deteriorated galvanized steel piping.

Other Reasons

There are several other reasons for poor water pressure. The main shut-off valve in the basement may be partially closed or obstructed. The city valve near the property line may similarly restrict flow. The supply line from the street to the house may be undersized, damaged or leaking.

Long runs of relatively small (1/2 inch diameter) pipe within a house will result in considerable pressure drop, especially with more than one fixture flowing. Replacement with larger pipe or shortening the runs are possible solutions.

A sludge build-up in a water heater can lead to poor hot water pressure. The tank should be flushed every year or so. A water softener, especially if not well maintained, can adversely affect water pressure.

A partially closed or obstructed isolating valve in the system can result in poor pressure in one part of the house. Adding plumbing fixtures without enlarging pipes or adding new ones will often lead to pressure complaints. This is common in single family homes which are duplexed or triplexed.

A crimped, damaged or clogged pipe within the house will adversely affect pressure. This is common with amateurish work. On a private system, a defective, undersized or poorly adjusted pump will result in poor pressure.

Galvanized Steel

1.4.2 Problems—Leaks: Galvanized steel piping will often leak first at the joints. Steel pipe has threads cut into it where it joins a fitting. The pipe wall is thinner at the threaded connections. As the piping rusts from the inside out, the pipe is most likely to rust through first at the threaded connections.

One of the phenomena with steel piping as it corrodes, is that it may rust through at one spot and begin to leak; however, the rust may form a scab over the leak and the leak may be intermittent as the rust progresses. This scabbing effect, if seen on the surface of the pipe will mean the pipe is close to the end of its life, even though it may not be actively leaking.

The interior of the pipe cannot be inspected. Observing the water pressure in the house is the only practical way to estimate the pipe condition. Since steel piping has not been used in single family homes since the early 1950's, it will be near the end of its life.

Leaking supply pipes can range from an annoying drip, to a major flood. In most cases, however, leakage appears first as a drip and progresses from there. With regular inspection, this can usually be picked up before serious flooding occurs.

Connections

Galvanized steel pipe is, of course, not the only pipe susceptible to leaks. Leakage as a result of a poor connection is often impossible to anticipate, and may be caused by vibration over a period of time. If a connection lets go suddenly, there will be a flood.

Damage

Mechanical damage will sometimes result in a leak immediately, although in other cases a joint is simply weakened and subsequent vibration will cause the leak sometime later. Concealed piping may be damaged by drilling or nailing into walls.

Dielectric Connectors

Special connectors, designed to prevent galvanic reaction, are often used where steel and copper piping are joined. These dielectric connectors separate the metals and reduce the deterioration. The performance reported of these connectors is good in some cases, but poor in others.

1.4.3.Problems—Freezing: Leakage can be a result of pipes freezing. A one-time freeze may not result in leakage. In some cases, copper piping for example, will develop a bulge although the piping may not split on the first freeze. Frozen pipes, of course, do not leak. They leak only as the ice begins to thaw. Some types of plastic supply pipe have better resistance to freeze-up than copper.

It is easy to see how pipes can freeze if they are installed in an unheated area such as a garage or crawl space. Inside the house, it is more difficult to understand why pipes would freeze, especially in a building that has been through several winters. Pipes which have been in place for fifty years can freeze if,

for example, an exterior wall is insulated from the inside of the house. If insulation is added on the interior (warm) side of the piping, the pipes which used to receive heat from the house are cut off from their heat source. Supply piping on exterior walls is always vulnerable to freezing.

In an old house, pipes running up to a kitchen sink may not have frozen in the past simply because the air under the sink circulated freely and kept the pipes warm. If the kitchen is remodelled, and a closed cabinet is provided under the sink, the same pipes may now freeze since they are cut off from the warm, circulating air.

Relocating a heat source may also lead to freezing pipes if the area around the pipes becomes colder as a result. This is common in remodelling projects where a bulky radiator is moved to make room for a cabinet. In many kitchen projects, the radiator is removed and not replaced with any heat source. The room may still be comfortable, but the pipes may not.

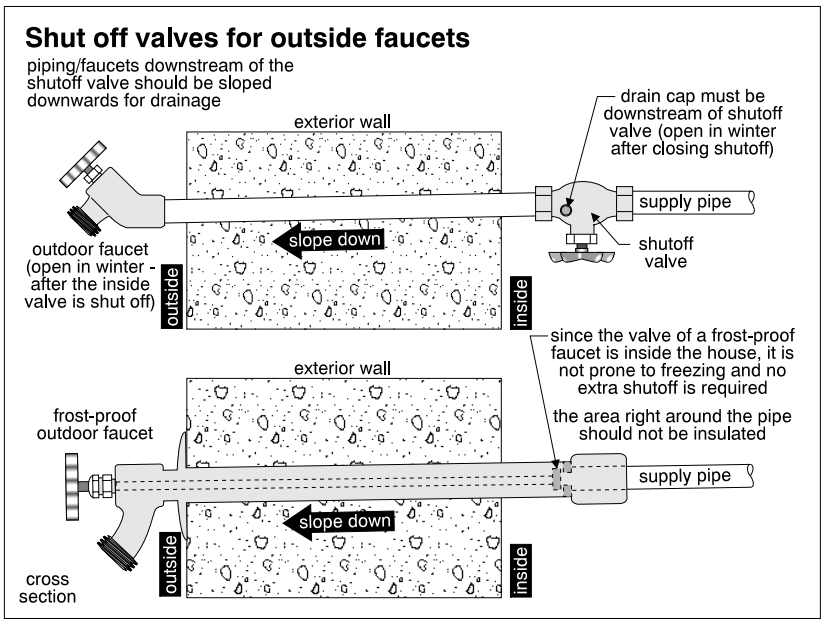
Solutions

Freezing pipe problems can be solved by providing electric heating cables. These electric cables are typically wrapped around the pipe or taped to the surface of the pipe. There are more sophisticated cables which can be run inside pipes, although these are not normally used residentially. Another solution is, of course, to relocate the pipes to a protected location.

Outdoor Faucets

Garden faucets have a valve on the outside for normal summer use, and an isolating valve inside the house. In the winter, the inside valve should be shut off, and the outside valve fully opened to allow any water to drain out. Some inside valves have auxiliary bleed valves to drain water which is downstream of the winter shut-off.

Many codes require back flow preventers on outside faucets to protect against cross connections. See 1.4.7.



There are special frost-proof outside valves which have long stems going through the wall, to shut off the water inside the building every time the faucet is used. These frost-proof valves do not require permanent shut off in the winter. Hoses must be disconnected and the values must be sloped to allow the valves to drain and prevent freezing.

1.4.4 Problems—Sweating: In some homes, the cold water piping is insulated to avoid sweating of pipes. On a warm humid day, the water running through a pipe will cool the air immediate adjacent to the pipe. If the air happens to be almost saturated at 70° F., cooling the air to 60° F. will result in condensation on the pipes. This sweating of the pipes can be annoying, and if allowed to continue, can cause water damage to ceilings, floors, furniture or storage. If a basement is to be finished, the cold water piping above the ceiling should be insulated.

It is sometimes difficult to know whether a pipe is leaking or sweating. On horizontal piping there are some clues which help. Condensation beads appear on the pipe uniformly around the diameter of a pipe and along its length. If one looks closely, a leak can usually be traced to a source from which water will only be running along the underside of the pipe. On vertical piping, the same difference exists, but once water starts to run down the pipe, it can be difficult to be sure.

Condensation can be controlled with insulation, whereas leakage requires a repair.

1.4.5 Problems-Noise Control: Noisy piping can be very irritating, although it is not often a serious problem. It is usually the result of pipes which are inadequately secured. When pipes are run up through walls, particularly when replacing older pipes with new, there is a tendency to feed pipes up through walls without breaking open any more wall than absolutely necessary. This may result in pipes which are not well secured as they pass through the walls.

As valves are opened and closed, vibration can be set up in the piping and it can rattle. Sometimes this can be corrected by pushing newspapers into the wall cavity to keep the pipes from contacting the walls or each other.

Where a pipe passes through the floor system or wood studs, for example, it may rub on the wood and squeak as the pipe changes dimension slightly. This is particularly noticeable on hot water piping, where the pipe will expand as it heats up. This can be corrected once the problem is isolated, by wrapping the pipe where it passes through the opening. In some cases, the opening has to be enlarged slightly.

Water Hammer

Water hammer (or hydrostatic shock) is a noisy pipe problem that is experienced when valves are shut off quickly. Water hammer can also set up enough vibration over a period of time to damage pipe connections and result in leakage.

The mechanism of water hammer can be explained as follows: water passing through a pipe is moving quickly and has a certain momentum. When the valve is shut quickly, the momentum of the water carries it into the valve with some force. Since water is essentially incompressible, a large pressure is built up as a result, There is very high pressure at the end of the pipe against the valve, and relatively low pressure upstream in the pipe. The high pressure water wants to flow to the low pressure area to neutralize the imbalance. This happens so quickly that a small vacuum can be created against the valve as the water moves away from it. This can result in cavitation, and the water being pulled back against the valve a second time. This continues back and forth in slowly diminishing shock waves. Pressures up to 600 psi can result from water travelling up to 3,000 miles per hour, for very short periods.

Water hammer can result in very loud noises in supply plumbing pipes. Water hammer is identified by noises which occur only as valves are closed. If a valve is closed very slowly, and the noise does not occur, one can be sure that water hammer is the problem.

The solution is fairly simple, but sometimes difficult to get at. Consider a pipe running up the wall and coming out at a bathroom basin, for example. Simply extending the piping (roughly twelve inches) up the wall behind the basin will solve the problem. These additional pipes, known as air chambers, extend straight up inside the wall, past the take off for the faucet. When the plumbing system is filled with water, these pipes will have air trapped in them. Since air is readily compressed, no matter how quickly the valves are shut off, the momentum of the water will be carried into the air, which acts as a cushion. The water is slowed down gradually, and water hammer will not occur.

Over a period of time, the air will be absorbed into the water and the air chambers will become ineffective. At this point the plumbing system has to be drained so that more air can be trapped in the air chambers. Simply draining and refilling the piping system will accomplish this.

There are special devices which can be purchased to control water hammer. These contain a diaphragm so that the air will not be absorbed into the water.

Water hammer is more of a problem with quick closing valves. and it is common with electrically operated valves on appliances such as washing machines and dishwashers.

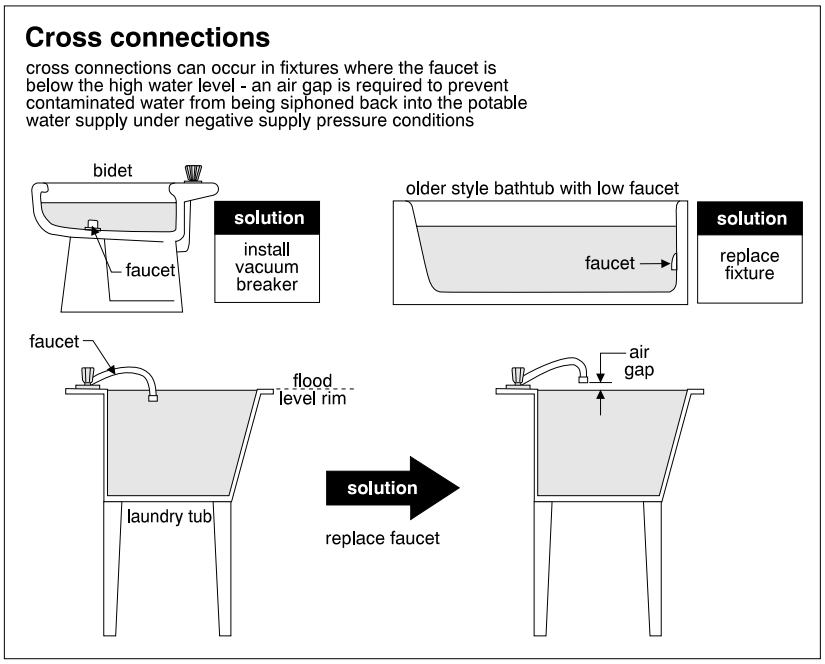
Exposed to Damage

1.4.6 Problems-Location: Pipes which are hung too low from the basement ceiling, or surface mounted on walls, may be subjected to mechanical damage. As much as possible, the pipes should be protected, and should never be located so that they can be pinched by a door which is opened too far, or be pushed out of position by storage against them. Where necessary, wood blocks can be run along beside pipes to protect them from damage.

Hangers

All piping should he adequately supported with hangers. Copper piping should not be supported with steel hangers because of the corrosion which will take place. Copper pipes should not contact heating ducts for similar reasons. Plastic piping should also be kept away from heat ducts.

1.4.7 Problems—Cross Connections: A cross connection is the name given to a situation where waste water could enter and contaminate the supply water. This, of course, is a health hazard and should be avoided. A cross connection may occur where a laundry tub, for example, has a faucet below the top of the laundry tub. If the faucets enter through the side wall of the tub, it is possible that when the tub is filled with water, the faucet will be submerged. If this happens, the waste water in the tub could get into the drinking water through the faucet if the supply piping is being drained.



The obvious solution is to raise the faucet set above the top of a tub or basin. This is common practice in modern plumbing, and cross connections do not occur under normal circumstances. Cross connections are also avoided through the use of an overflow. In bathtubs, for example, where the faucets may enter through the wall of the tub below the top, an overflow provided below the faucets will prevent a cross connection.

Bidet

Some plumbing fixtures necessarily create a situation which could lead to a cross connection. A bidet is a good example of this. A bidet has a water supply at the bottom of the bowl. This allows water to be directed up in a spray from the bottom center of the bowl. There is, of course, the potential for waste water in the bowl to get into this supply water. A special device (vacuum breaker) located at the control valves for the bidet, prevents any water from flowing back into the supply plumbing.

Garden Hose

While cross connections are normally avoided during original plumbing work, home handyman changes can defeat this. Careless use of the house plumbing system can also create a cross connection. Care should be taken, for example, to avoid placing a garden hose in a position to allow waste water to flow back into the supply plumbing system. For example, if the hose is used on the outside of the house while cleaning windows or gutters, and the hose is left in a pail of water, it is possible for the contaminated water to flow back through the hose into the drinking water. This may happen if the house water supply is shut off and partially drained for some reason, while the hose is in the pail.

Boiler Connection

On hot water heating systems, the plumbing is connected to the boiler so that water can be added to the boiler. Modern installations have a back-flow preventer to prevent the boiler water from coming back into the drinking water. This is another form of cross connection. Older systems do not have back-flow preventers to protect against this. Where no back-flow preventer is provided, a heating specialist may recommend one.

1.5. Isolating Valves: The purpose of an isolating valve is to allow someone to work on a part of the plumbing system without shutting off the entire house water supply. Almost every toilet has an isolating valve, and there should always be an isolating valve on the cold water supply to the hot water heater. Although not often installed, it is desirable to have isolating valves on every set of risers running up from the main feeds in the basement, and isolating valves under each sink and basin.

Leak

Problems: The most common problem experienced with isolating valves is leakage through the valve connection, packing or washer.

Inoperative

A problem that is often not noted until the valve is needed, is an inoperative valve. Many toilet isolating valves become stuck, and are therefore useless. This is very frustrating, since it is usually an emergency when the valve is tried. Replacing the isolating valve is not a large expense. If an isolating valve cannot be closed, the main water shut off to the house can be used in an emergency.

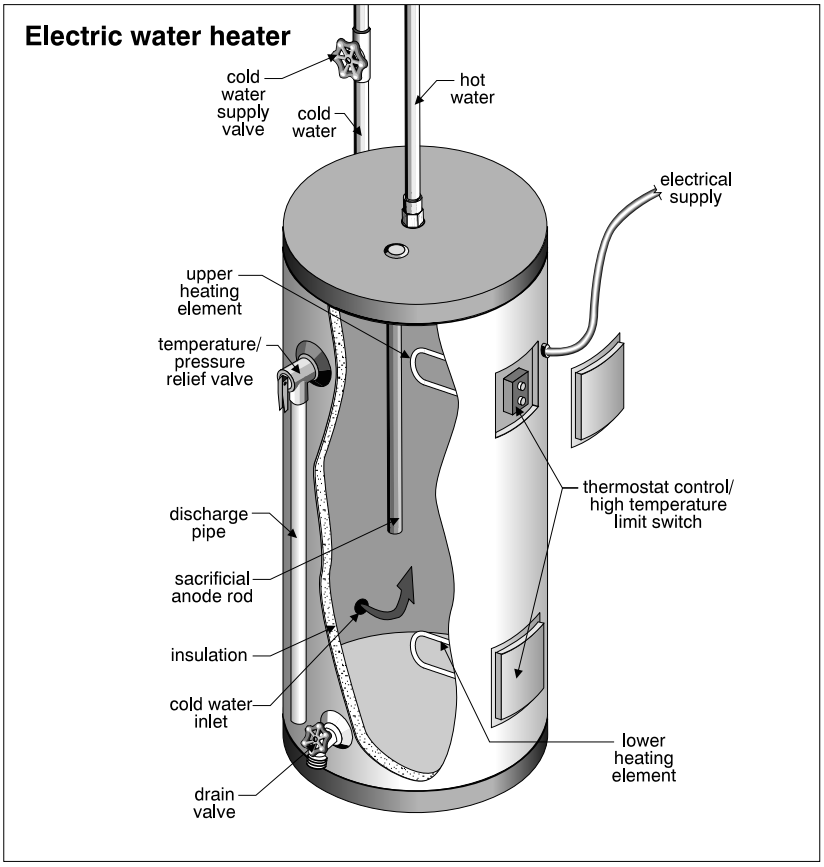
If an isolating valve does not turn with normal effort by hand pressure, a wrench should not be used unless one is prepared to shut off the main supply valve very quickly if the valve is damaged. Sometimes forcing a valve will not break it, but will result in leaking afterward.

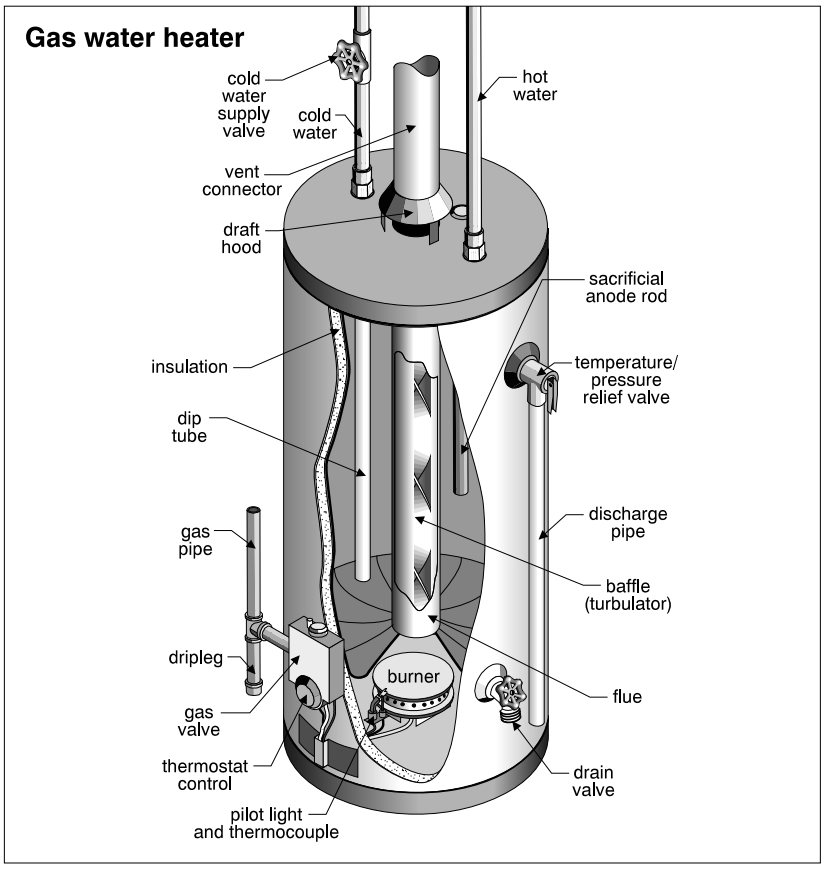
Water Heater

It should be remembered that when the hot water system is to be drained to work on the system, an electric or oil-fired hot water heater must be turned off. A gas fired heater should be set to the pilot position.

1.6 Water Heaters: Water heaters may be gas, oil or electric. In some cities, it is possible to rent water heaters from the utilities or oil companies. This is usually less expensive than owning a heater. The life expectancy of a water heater is typically eight to twelve years, although there are exceptions on both sides. If the heater is a rental, or is owned but rentals are available, there is very little concern.

Life Expectancy





How They Work

Whether gas, oil or electricity, all water heaters operate in essentially the same way. The cold water enters the glass lined tank from the source, and heated water leaves the tank. The water temperature is typically 140° F. When hot water is removed from the tank (by opening a hot water faucet in the house), cold water enters the tank, triggering the thermostat. Eventually the tank will cool down, since heat cannot be added to the incoming water as quickly as the hot is drained off. The larger the tank, the longer it takes to run out of hot water.

Size

Water heaters should be of adequate size to satisfy the needs of the house. In a rental situation, it is easy to replace a small heater with a larger one, or to add a second hot water heater. A family of four will often find a 30 gallon gas or oil system or a 40 gallon electric system satisfactory.

Recovery Rate

When the hot water is depleted, the recovery rate of the heater becomes important. Generally speaking, oil has the fastest rate of recovery, with gas second and electricity third, depending on the size of burner or element. If water is drawn off slowly, the recovery rate may be such that the tank can be kept filled with 140° F water. The faster the recovery rate, the more water that can be used without running out of hot water.

Insulation

The tanks are insulated to slow the heat loss from the tank. More energy efficient tanks have better insulation. Some people also insulate their hot water piping.

Temperature Settings Thermostats control the water temperature. Dishwasher manufacturers often recommend that the water be 140° F. Some dishwashing detergents will not dissolve completely at lower temperatures. To save energy and avoid burns, 115 to 120° F is a better setting. Some dishwashers can now heat their own water, so the water heater setting can be lowered.

Tankless Water Heaters Tankless, coil, or instantaneous heaters can be used with hot water or steam boilers. Cold water is heated by passing through a coil in the boiler or a heat exchanger attached to the boiler. These units, which are often undersized, usually have no storage tank. The house boiler must be run year round. This wastes energy and reduces the boiler life. Since the boiler water temperature varies, a mixing valve (manual or automatic) should be provided. The coils frequently scale up, reducing hot water pressure. Replacement with a tank system is usually recommended.

Fuel Problems: Whether gas, oil or electric, the water heater must have a continuous fuel supply. Gas piping should be steel, not aluminum, copper or brass. Any gas odor is a serious problem. Malfunctioning burners, pilot lights, controls or electrical elements will cause poor operation or may result in the system not working at all. Oil burners should be serviced annually. Many experts recommend draining one or two gallons out of the bottom of the tank monthly to prevent sludge build-up.

Exhaust Venting Most gas and oil water heaters have to be vented into a chimney with adequate draft. Poorly arranged or disconnected vents are safety hazards which should be corrected promptly. Aluminum vents are not permitted. Vent sections should be screwed together, and should slope up 1/4 inch per ft., minimum. Vents should extend 2 ft. above the roof and should be 2 ft. above anything within 10 ft. horizontally. Vents should extend at least 5 ft. above the draft hood. Exhaust gases spilling out at the draft hood or burner may present a life threatening situation. This problem requires immediate action. There are some modern mid-efficiency gas water heaters which employ induced draft fans to vent straight out through the house wall.

Location Gas or oil water heaters should not be in sleeping areas. Gas fired heaters in garages should be 18 inches above floor level, and protected from mechanical damage.

Electric It is not unusual to find one of the two elements in electric water heaters burned out. Replacing an element is not expensive. Most heaters are wired so that both elements cannot be on at the same time. Depending on which element fails, there may be some hot water, or none.

Leak and Damage Hot water heaters can, of course, leak, and the tanks can be mechanically damaged.

Sludge Where sludge has accumulated in the bottom of the tank, water pressure from the hot water system may be limited. When water pressure problems are experienced on the hot water system only, it makes sense to drain the hot water heater to ensure that sludge accumulation is not the problem.

Hot/Cold Reversed

Since the piping connections into hot water heaters are often both at the top, it is easy to reverse the connections. The cold water connection on this type of tank has a long tube which extends down through the tank, so that the cold water is introduced at the bottom. The hot connection simply allows heated water to be drawn off the top of the tank. Reversing the connections on this pipe will lead to very inefficient performance.

Relief Valve

Discharge Tube

The temperature/pressure relief valve lets water escape if the temperature or pressure is too high. This valve should be connected to a tube which discharges 6 to 12 inches above floor level so hot water won't be sprayed on to anyone nearby. Some codes require that the tube discharge outside the building. The tube should be as large as the tank fitting and the tube end should never be threaded, capped or plugged. The tube should be able to withstand 250°F temperatures, should have no shut-off valve, and should be as short and as straight as possible. An alternative to the temperature part of the relief valve is a device which shuts off the fuel supply if the temperature is too high.

Rental

With rental units, the utility, oil or gas company will look after the repair.

1.7 Hot Water Circulating System: Some high quality homes have a system to constantly move the hot water through the heater and hot water distribution piping. This feature eliminates the need to wait for several seconds to get hot water out of a tap, for example, first thing in the morning.

In a conventional system, the water is heated at the hot water tank and then enters the distribution piping. The hot water in the pipe cools down to room temperature over time. When a faucet is opened, the cool water in the hot water pipe must be run through before heated water from the tank gets to the faucet.

The hot water circulating system forms a large loop, and the water is moved slowly through the system even when no faucets are flowing. The water does not have a chance to cool down, since it is passed through the water heater every few minutes.

Problems:

Like all electrically driven pumps, the motor can fail. The motor may also be warm or noisy, indicating problems. The pump can be seized, damaged, worn or leaking.

The hot water circulating pump systems are normally set up so that if the pump is inoperative, the hot water supply in the house can still be used in a normal fashion. This will not provide the hot water instantly, but beyond this, does not create a problem.

1.8 Inappropriate/Low Quality Materials: Many materials used for supply plumbing were not intended for this use, and when installed may be expected to have a short and troublesome life. These materials include rubber hoses, garden hoses, and non-certified plastic piping. Connections made with the wrong materials or wrong devices cannot be expected to perform properly. Special connectors are provided for special types of piping.

► 2.0 WASTE SYSTEMS

Only a small percentage of the waste piping system is visible. No comments can be offered during a home inspection on concealed piping.

2.1 Public: Most houses in built-up areas are connected to a municipal sewer system. This is a system in the street which allows waste from a house to flow by gravity into sewer piping. The waste is carried to a treatment facility where it is cleaned prior to being released.

Combination Sewers

In older neighborhoods, a combination storm and sanitary sewer was employed. In modern areas, and where sewer pipes have been replaced, there is a sanitary sewer to carry house waste and a separate storm sewer to carry rain and snow run off.

Shallow Sewers

Where the street sewers are not deep enough, the main drain pipe from a house must leave the house above the basement floor. This means that plumbing fixtures cannot be put in the basement without the waste being pumped up to the main drain level. A basement floor drain in this situation would also require special attention.

Risk of Back-up

A street with a storm sewer and sanitary sewers is more desirable than a combination sewer. Basement flooding as a result of storm sewer back-up is less likely in a house with separate sewers. With combination sewers, if there is a large volume of storm water, the sewers can be overloaded and water (including raw sewage) can back up through basement floor drains. In some areas, this problem is common and some homeowners install one-way valves in their floor drains which allows water down into the drain, but prevents water from coming back up. If pressures are high enough, sewage may back up through basement plumbing fixtures. In some cases, a check valve is put into the main drain line itself. These are obviously short term solutions at best and, ideally, the city should be petitioned to improve the sewer system.

Floor Drains and Downspouts

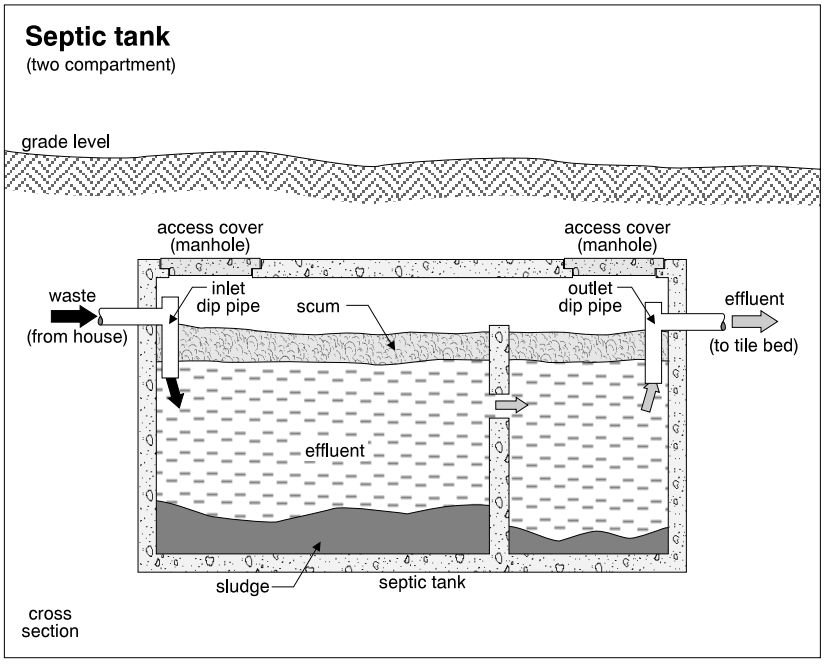
Where there are separate sewers, the floor drains should go into the sanitary sewer and gutters and downspouts should go into the storm sewer, or onto the ground several feet away from the building.

Overloaded Drain

Although it is rare, it is possible that a house with a city sewer system is refused permission to add more plumbing fixtures. There are a fixed number of fixtures which can drain into any given size of drainage pipe. This can be an unexpected stumbling block during a house expansion or renovation.

2.2 Private: The most common private sewer system is a septic tank and weeping tile bed. This system is employed in houses where city sewers were not available when the house was built.

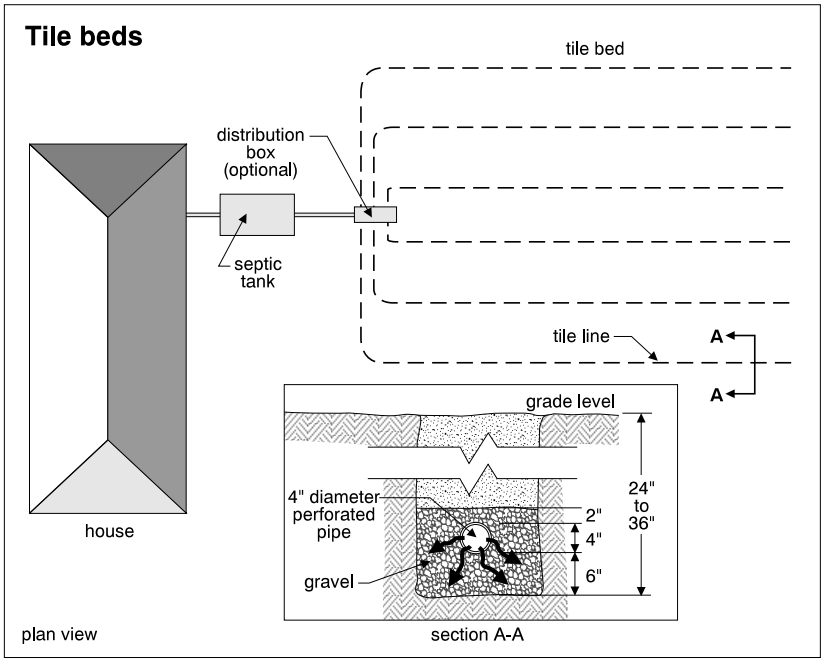
The septic tank is a watertight container usually made of concrete, steel or fiber glass. It serves as a holding tank which allows heavy solids to settle to the bottom of the tank. Lighter materials which float are also in the tank. The heavy solids are known as sludge and the lighter floating materials are known as scum.



Most of the material which enters the tank is in a liquid state. Within the tank, the majority of the solids are broken down to gases and/or liquids. The break-down takes place as a result of bacteria action, both aerobic and anaerobic. The liquids are discharged from the tank into the tile bed. The gas escapes through the plumbing vents.

The tile bed is also known as a leaching bed, disposal field, soil absorption field or drain field. It consists of a network of perforated or open jointed pipes in trenches below the ground surface which allows the liquid waste (effluent) to percolate into the soil. The size of the leaching bed is dependent upon the ability of the soil to absorb the effluent, and the amount of waste the system receives.

There are variations on the conventional septic system, including closed holding tanks, which are pumped out on a regular basis. There are also more sophisticated systems wherein agitators and aerators are employed to accelerate the chemical decomposition of the solids in the tank. The bacterial action in these systems is aerobic only. These systems allow the use of smaller tile beds and are of particular value on smaller properties. While there is an advantage to this, the presence of electrical and mechanical parts creates the potential for higher maintenance.



Special sand can be used which allows very small tile beds to be installed. This is expensive, since the sand has to be brought onto the site, but it may be important to keep the tile bed small. These special tile beds are used with conventional septic tanks, or can be used with the mechanically assisted systems described above.

Septic systems should be kept well away from supply wells and other sources of drinking water, for obvious reasons. Generally speaking, a well and a tile bed should be at least one hundred feet apart. A well and septic tank should be at least fifty feet from each other.

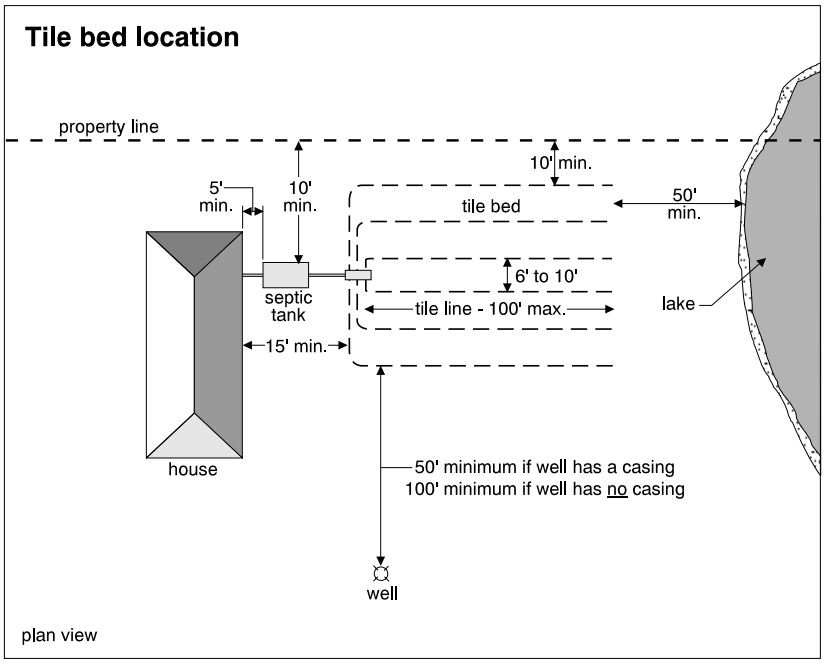
It is helpful to know the exact location of the tank and tile bed, the age of the system, and as many of the installation and service history details as are available. Where building expansion is planned, it is necessary to know where the tank and tile bed are. The tile bed location is often indicated by greener, healthier grass growing above the bed. The health and environment authorities may have a record of the location.

In some situations, it is not possible to determine whether the house waste system is public or private. Where there is any doubt, this should be checked with the vendor.

Problems

Odor and Pooling

A septic system which is not performing properly can pose a health hazard and should be treated as a high priority problem. The overall condition of a septic system and tile bed cannot be well evaluated during a visual inspection. The homeowner should watch for water pooling above the tile bed, or an odor coming from the bed. Homes which have been vacant for several months may show problems when the system is pressed back into service.



Problems which lead to failure of septic systems include overloading of the tile bed, soil breakdown around the tiles, high water tables, clogging of the tiles, and broken or cracked tanks and tiles.

Solutions

Solution alternatives include repairs to broken or damaged components, relocation of the tile bed, bringing in special soil, and reducing the load on the system. Identifying the cause of failure and suggesting the correct solution is a job for a specialist.

Maintenance

Septic systems require regular maintenance. The system should be inspected annually and the tank should be pumped out every two to four years, as required. Tile beds do have a fixed life expectancy (often considered to be roughly twenty-five to thirty years). This depends on a great many factors and is very difficult to predict. Bleaches and strong detergents should be avoided where possible, since they may kill the bacteria in the tank. The amount of water entering the system should be minimized. Water saving toilets and shower heads are a good idea.

City Sewers

There are several areas where houses with original septic systems can now connect to street sewers. The connection to a municipal system can be well over a thousand dollars in municipal fees and connection charges alone. There are also plumbing costs to make the connections, which are the responsibility of the homeowner.

In most cases, abandoning a septic system which is in good working order is not cost-effective. Where the land is to be used to provide a building addition or swimming pool, of course, it is necessary to replace the septic system, despite its serviceability. Incidentally, it is very important to know the location and size of a septic system if any building expansion is planned.

Building Addition

Local authorities may refuse to allow an addition to a home, depending on septic system capabilities. A new septic system, if required, will add significantly to the cost of the addition.

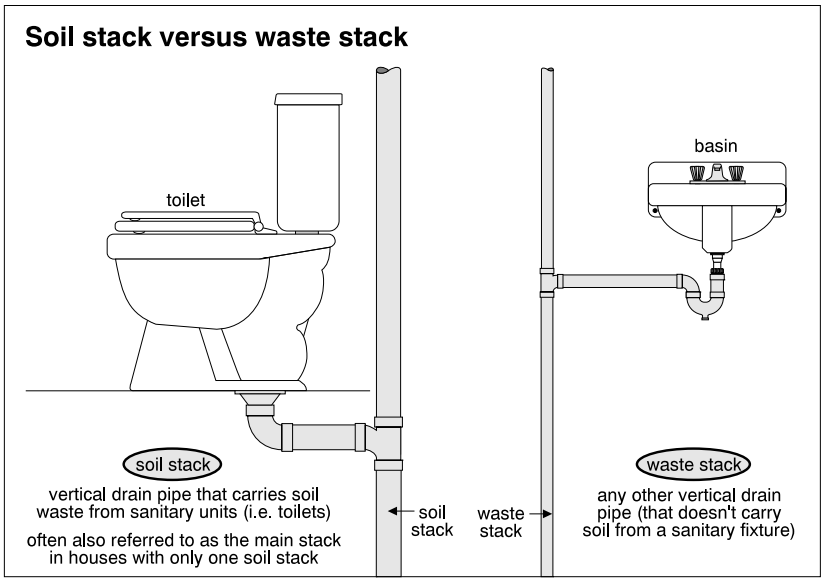
2.3 Waste Piping in House

Typical Materials

Galvanized Steel: Galvanized steel plumbing on the waste system is used in some areas solely for vent pipes. Vents carry air but do not carry water. The galvanized vent piping is not, therefore, subject to the same rusting problems as galvanized steel supply piping. Its life expectancy is very long, easily more than fifty years.

In other areas, galvanized drain and waste pipes were used. These have a relatively short life expectancy since the steel corrodes and the rough inner surface created by the corrosion can cause blockages as solids get hung up.

Copper: Copper waste plumbing was used commonly after World War II, up until the mid 1960's. Copper piping was used for branch drain lines, main stacks, and vent piping. It performs all of these functions very well. In single family residential use, it has become rare, since plastic waste plumbing is much less expensive to purchase and install. In multi-family construction, copper waste plumbing is sometimes used where authorities will not allow combustible plastic piping.



The joints in copper piping are soldered and an indefinite life expectancy is projected under single family residential conditions.

Plastic: Since the 1960's, ABS plastic piping has become almost the exclusive waste plumbing material. It is used for drains, wastes and vents and is connected by using a plastic cement (glue). The piping is inexpensive, easy to work with and as far as we know, very durable. Its only disadvantage is that it is somewhat noisy when water is running through it. Efforts to control the noise include wrapping it with fiber glass insulation.

Cast Iron: Cast iron piping was used for the main stack in houses up until the 1950's. Its life expectancy is projected to be fifty years and up. It employs a bell-and-spigot connection traditionally with oakum packed into the joint and caulked with lead to seal it. There is also hubless cast iron pipe joined with neoprene sleeves clamped over the joint. Cast iron is expensive and awkward to work with, because it is very heavy.

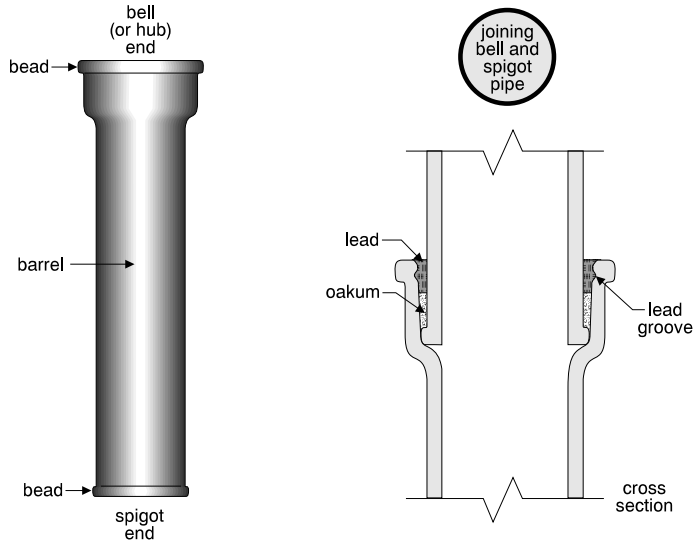
Cast iron waste piping generally fails in one of two ways. The pipe can rust through, often in a pin hole pattern. It is also prone to splitting along a seam, particularly on horizontal runs.

Lead: Lead waste plumbing was used up until the 1950's, to connect plumbing fixtures to a main cast iron or copper drain. Lead was used because of its resistance to corrosion, and its workability. A piece of lead pipe can be bent fairly easily by hand.

Lead piping, because of its age, is prone to leakage, usually at the connections. It is typically replaced with ABS plastic pipe. Lead waste lines are usually replaced during any major plumbing work, whether problems are being experienced or not. Lead waste plumbing does not create a health hazard in terms of lead content, since it only contacts the waste water.

Lead Suspected: Since the sections of lead piping used are relatively small, they are often not visible. In houses built before the 1960's, where substantial updating has not been done, it is reasonable to assume that concealed lead waste plumbing exists. Where this is the case, the plumbing system is considered susceptible to leakage. The lead should be replaced, of course, when leaks appear or during any other work in the area.

Cast iron waste pipe - bell and spigot
(sometimes called hub and spigot)



2.3.1 Problems—Leaks: Leakage from a waste plumbing system can, of course, be a health hazard and should be corrected immediately. Leakage may be the result of poor connections, mechanical damage or deterioration of piping. Since the majority of the waste plumbing system in a house cannot be seen, waste plumbing leaks can go undetected for some time, particularly if the amount of water flowing through the pipes is not great. Occasional use fixtures will often have small waste plumbing leaks which are not identified for months or even years.

Corrective action may be patching, or replacement, typically with ABS plastic. Old lead piping is prone to leakage and should be watched closely. It should be replaced if any plumbing work is done on nearby supply piping or fixtures. Similarly, when cast iron waste piping develops several pin hole leaks, or cracks at a seam, it is typically replaced with ABS plastic.

2.3.2 Problems—Slope: Waste plumbing pipes are often run almost horizontally. Since they depend on gravity for drainage, they must have at least some slope. The slope recommended is typically one-quarter inch per foot. Over time, with house settlement or pipe sag, the minimum slope can be lost. Low spots in waste plumbing may lead to a build-up of waste, effectively reducing the diameter of the pipe, and ultimately result in a blockage. This situation should be watched for and corrected where identified.

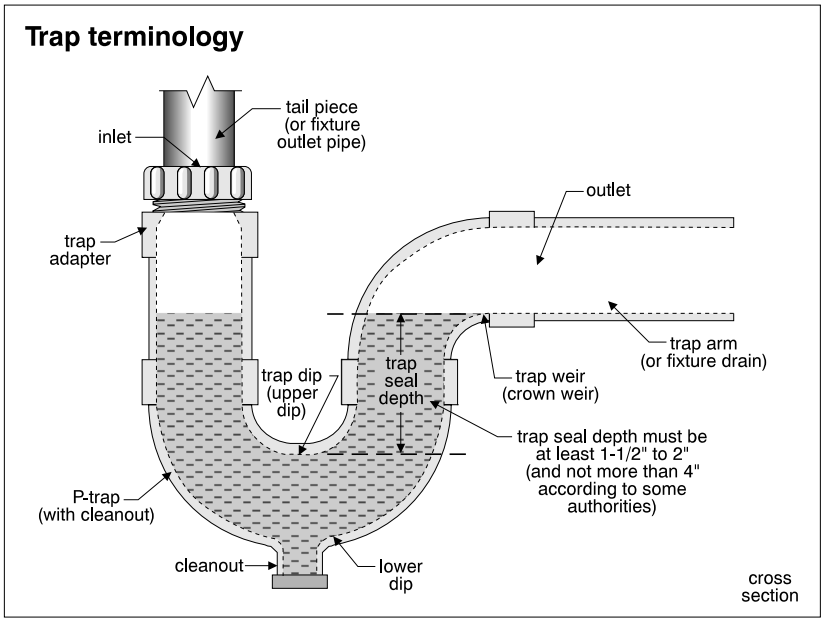
Too much slope on horizontal lines can cause siphoning at traps and poor drain performance. Codes specify maximum pipe slopes. The horizontal drain slope should be such that the fall front the trap water level to the vent is not greater than the pipe diameter. A good rule of thumb is five feet as a maximum distance between a trap and a vent. (See Section 2.6)

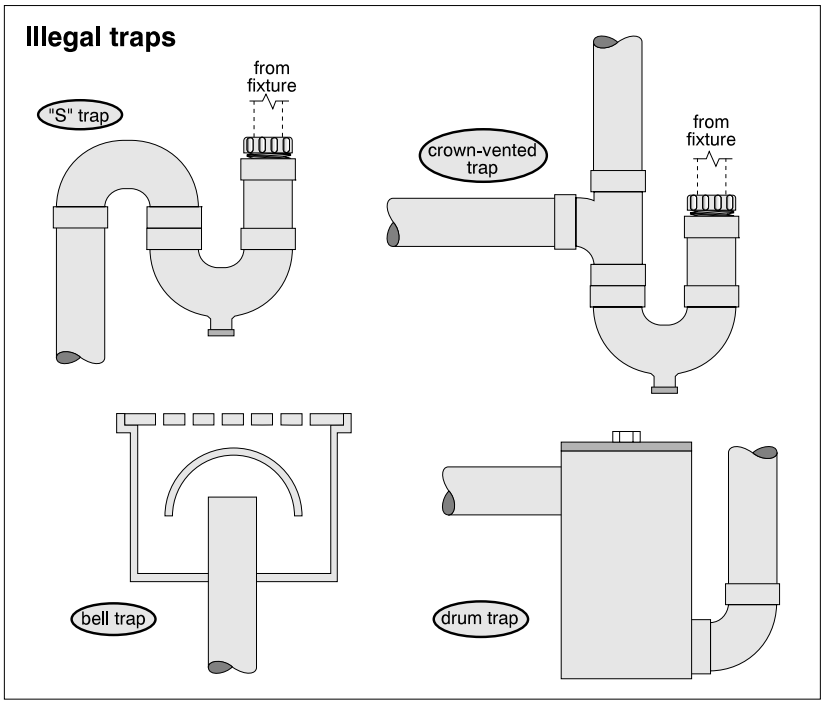
2.3.3 Problems—Freezing: Waste plumbing systems are susceptible to freezing, but to a lesser extent than supply plumbing pipes. The reason for this is that the waste piping normally has no water in it. Traps, however, do have water in them all the time and will freeze. Replacing the trap water with anti-freeze is common practice on seasonal buildings.

2.3.4 Problems—Obstructions: Clogs often develop at traps because the tight comers tend to collect foreign material. Traps should be arranged so that they can be removed easily to clear obstructions. Modern household traps often include a drain plug at the trap bottom. This is useful for removing objects such as rings which are dropped down drains, but may not be large enough to allow clearing of an obstruction. Obstructions are sometimes cleared with plungers or plumber's snakes. In some cases, the piping has to be dismantled. This work can create a health hazard, and great care should be exercised when dealing with any waste water problems. Tools, for example, should be washed after use.

Older homes have traps out in the front yard on the main waste system. These are common spots for obstructions. The waste line outside the house is also vulnerable to tree roots. Where the pipe has not been seriously damaged, a plumber's snake may clear a blockage. If the pipe is broken, digging and replacing are necessary.

2.4 Traps: Traps are provided below house plumbing fixtures and are designed to hold some water in the waste piping system. The purpose of a trap is to prevent sewer odors from coming back through the fixture drain when it is not in use. There are several different styles of traps (P traps, S traps, and Drum traps, for example). The P traps are considered the best residentially, as they are least vulnerable to siphoning or obstruction problems.





Most fixtures require traps, although a toilet does not, since the water in the toilet bowl creates a natural trap. Dishwashers are usually effectively trapped, although there is no formal fitting. The drain line from the dishwasher should be arranged to form a trap.

Trap Prime

Since the 1960's, it has become popular to provide a prime for traps in basement floor drains. This is usually accomplished through a one-quarter inch clear plastic tube which is connected to a regularly used plumbing fixture. This may be a laundry tub faucet or toilet, for example. Whenever the fixture is run, a small amount of water is taken off and is carried through the plastic tube into the floor drain. Water is added to the trap on a regular basis to replace any water lost through evaporation. The same thing could be accomplished by pouring a bucket of water down the drain every month or so. Another solution is to fill a floor drain trap with mineral oil. It will not evaporate and is environmentally safe. When the water level in a floor drain is noted to be low, it should be filled and the water level watched to see if there is a leak. A leak requires digging up and replacing the trap.

Problems

Missing and Leaking

Amateur plumbers' work may omit traps, and traps which leak are, of course, ineffective. Leaks in traps under sinks can usually be seen easily, but leaking traps under concealed fixtures such as bathtubs and shower stalls may not be noticed until considerable damage is done below.

Basement floor drain traps which crack are often not detected for some time. A sewer odor or movement of air up through the drain, may indicate a problem with the floor drain trap. (Air movement may simply be the result of downspouts discharging into the floor drain above the trap. It is also possible that the water has simply evaporated out of the trap.)

Freezing

When a house is winterized, the supply plumbing pipes are drained. The waste pipes contain no water and they are not susceptible to freezing. The traps, however, could freeze. The traps cannot simply be drained, since sewer odors will enter the house. Consequently, anti-freeze is provided for the traps. Since this anti-freeze will ultimately be flushed into the waste system (either city or septic), the anti-freeze should be a type that will not harm the environment.

Double Traps

Two traps are not permitted on any plumbing fixture. This arrangement may produce chronic blockages.

2.5 Floor Drains: Floor drains should be provided at the lowest living level of any house. Floor drains can be inadvertently covered if the basement floor is resurfaced. If the basement floor is lowered, the floor drain may be unwisely deleted. Where an addition is provided, there may be no floor drain for this section of the basement. If this is lower than the original basement, this is a risky situation.

The floor drain should be located at the low point in the floor. This is always a compromise to some degree, since people do not like their basement floors to slope dramatically. The slope is often subtle, and in many cases the floor drain is not at the lowest point in the floor. In other cases, there is more than one low spot with a ridge separating them. Typically, only one of these areas will have a drain.

There should be a grate over the floor drain to prevent the introduction of foreign objects. The grate should not be allowed to become clogged.

It should be ensured that there is water in the floor drain trap. It is not uncommon to have trap leakage at floor drains. Sewer odors are often noted at floor drains as a result of unsealed traps.

Floor drains are reasonably expensive to add after the fact, and can often not be seen during a visual inspection. When possession is taken, the homeowner should ensure that floor drains are provided where needed. Floor drains are often located close to the boiler or laundry area, where leakage is most likely.

2.6 Venting: One of the least understood sections of a waste plumbing system is the venting. For water to drain freely out of a house waste system, there must be adequate venting. The venting performs three functions. It allows air in front of the water rushing through the waste pipe to be pushed out of the way, and it also allows air to be reintroduced to the waste piping after the water has gone by. Lastly, it allows sewer gases to escape outside through a vent stack.

Siphon

The second function is the most important. The trap at each plumbing fixture provides a water seal which prevents sewer odors from entering the house. After a fixture is used, there should be enough water left in the trap to provide a good seal. If a waste system is not properly vented, when the water runs through the drain line it will siphon the last bit of water out of the trap. As a column of water runs through a pipe, it is difficult to separate that column of water into two pieces (leaving the last part in the trap) because the space in the middle forms a vacuum. The water in the trap is siphoned out and down the drain.

It is important to have a vent connection just downstream of the trap. This allows air into the pipe, preventing a vacuum between the water which runs down the drain pipe and the water which remains in the trap. With the exception of floor drains under some circumstances, all fixtures should be vented.

As a rough rule, any fixture within five feet of the main stack does not need a separate vent. Where fixtures are more than five feet from the main stack and do require a separate vent, the vent must extend above every other fixture in the house. At this point it may join the main stack. It is, therefore, possible for a house to have several bathrooms, and only one vent stack going up through the roof.

Typical Materials

Vent piping may be cast iron, copper, galvanized steel or plastic.

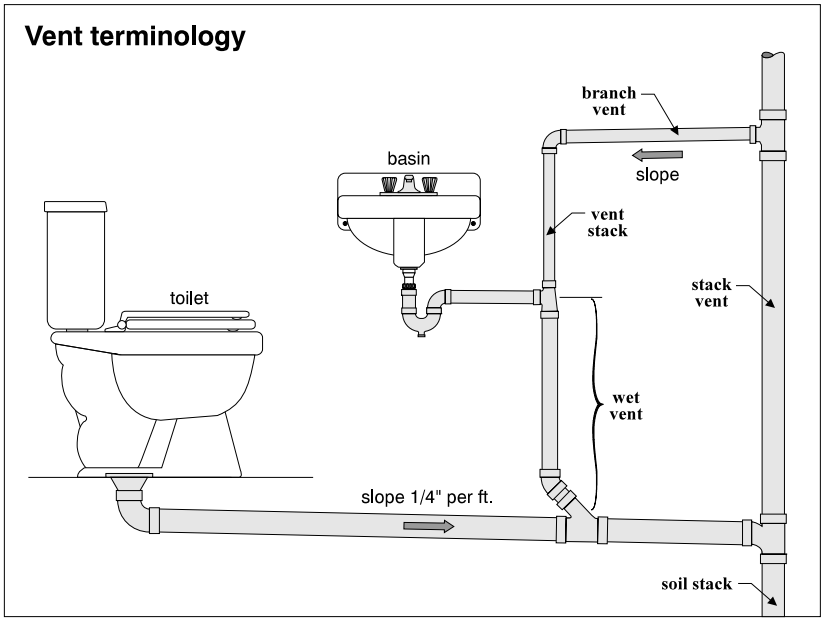
Problems

Missing

Inadequate venting is typified by a siphoning or gurgling noise when water is drained out of a plumbing fixture. A sewer odor at a fixture usually indicates a trap or venting problem. The venting system is almost always concealed from view, except in a few small areas.

Location

Vents should terminate at least 3 feet above and 10 feet (12 feet in Canada) in any other direction from any door or window openings. Vents should extend at least 6 inches above the roof and be at least 12 inches away from a wall.



Too Short The vent pipe should extend at least six inches up through the roof of the house. In some cases, the vent terminates in the attic which may allow odors to find their way into the house. Also, in cold weather, this can add very moist warm air into a cold attic, leading to condensation and frost damage of the wooden attic members.

Too Tall The vent should extend only about twelve inches above the roof line. Vents which are very long may be subject to frost closure in the winter. The warm moist air passes up through the vent, and the air is cooled as it contacts the cold walls of the outdoor section of the vent pipe. The moisture in the air condenses and freezes on the walls of the vent pipe. In a prolonged spell of cold weather, this frost can build up to a point where it closes off the top of the vent. This, of course, negates the effectiveness of the venting system. Vents should be at least three inches in diameter where they penetrate the roof system in order to avoid frost closure.

Frost Closure Vents which extend more than twelve inches above the roof should be watched for frost closure problems. In some cases, the vents can simply be cut shorter. In other cases, where the vent is extended to carry odors up past a window, it may be necessary to use a larger diameter vent. A frost closure problem can usually be solved temporarily by pouring a kettle full of just-boiled water down the vent from the top.

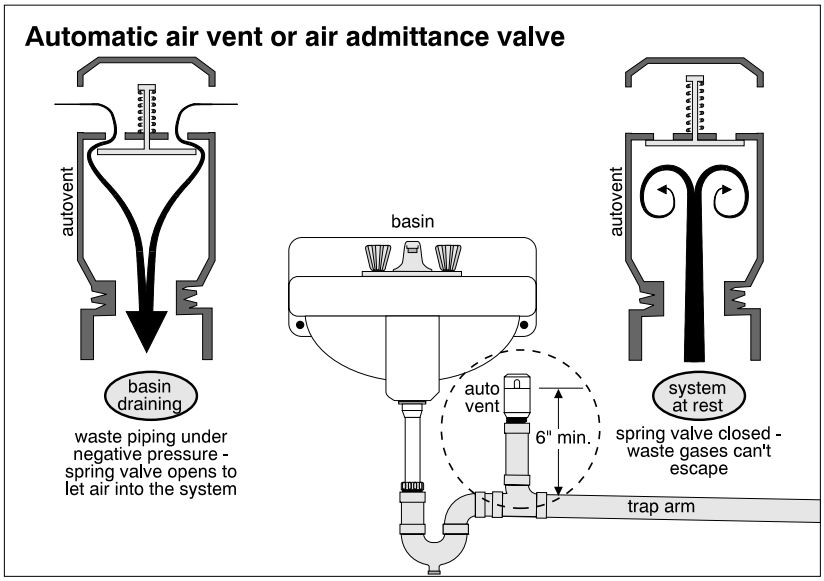
Connection and Pipe Support Since the venting system only carries air, leakage is usually not a big problem. Deterioration of the piping is also very unusual, although poor connection or poor pipe support is a possibility. The vent piping is usually exposed in the attic, and it is here that it may be vulnerable to mechanical damage.

Wet Vents Wet vents (vents that also serve as drains) can become clogged or deteriorate as a result of the waste flowing through them.

Roof Leaks Roof leakage around the vent stack flashing (where the stack penetrates the roof) is often mistaken for plumbing leakage. A vent stack passing through the roof membrane, creates an inherently weak spot in the roofing system. If leakage occurs here, the water may run down the outside of the vent stack, and appear near a plumbing fixture in the house. It is possible to look for a long time for intermittent leaks in the waste plumbing system which do not exist. By paying careful attention to when the leak occurs, it may be found that the apparent plumbing leakage occurs only during or after a rain.

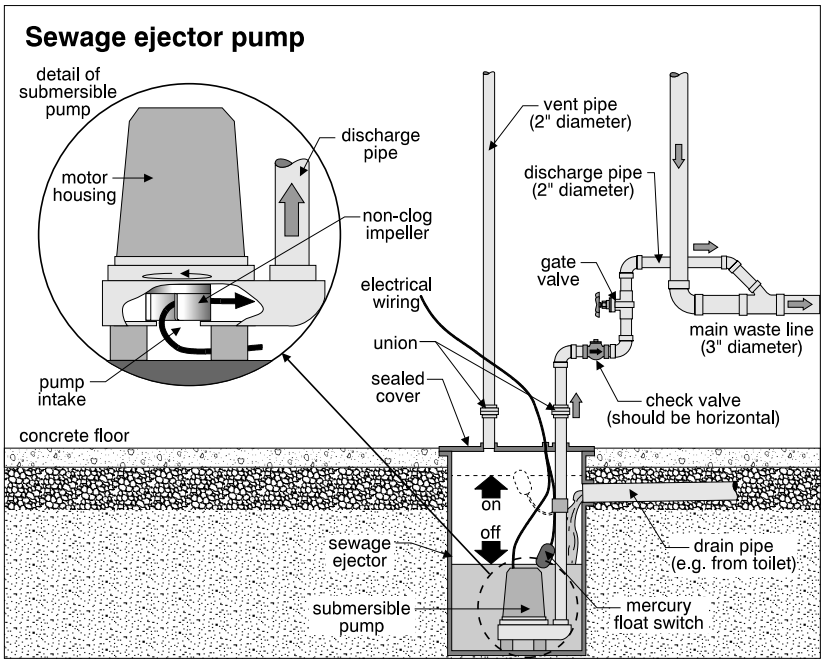
Outside Vents When a basement bathroom is added to a home, it is difficult to run a vent pipe up through the house and roof. Often, a vent is run out through the wall and up the outside of the building. This is acceptable although not attractive, and frost closure problems are more likely with this arrangement.

Automatic Air Vents Where an individual fixture has been installed without appropriate venting, it is expensive to break into walls and ceilings to add proper venting. Mechanical devices which simulate conventional venting are available, although not approved by many plumbing authorities. These devices, known as automatic air vents, are essentially vacuum valves which allow air to be drawn into the waste plumbing system when negative pressure exists, but prevent any air escaping from the plumbing system under positive pressure. These devices provide a low cost alternative to conventional venting for all fixtures except toilets. Again, some plumbing authorities will not allow these.



2.7 Solid Waste Pumps: Solid waste pumps are used where conventional gravity flow cannot carry plumbing waste away. Fixtures in the basement of a house with a septic system usually need a solid waste pump to carry the waste up to the main sewer line. These systems are expensive and relatively complex.

These solid waste pumps are submerged in a tank with a sealed top. The house plumbing fixtures drain into the tank. When it is filled to a given level, the pump comes on, discharging the waste through a line which goes to a city sewer or septic system. The incoming line is typically three inches and the discharge line is usually two inches in diameter. A vent pipe is typically connected to the top of the tank. A float or diaphragm liquid level sensor activates the pump. Some have high liquid level alarms which notify the homeowner of a malfunction.



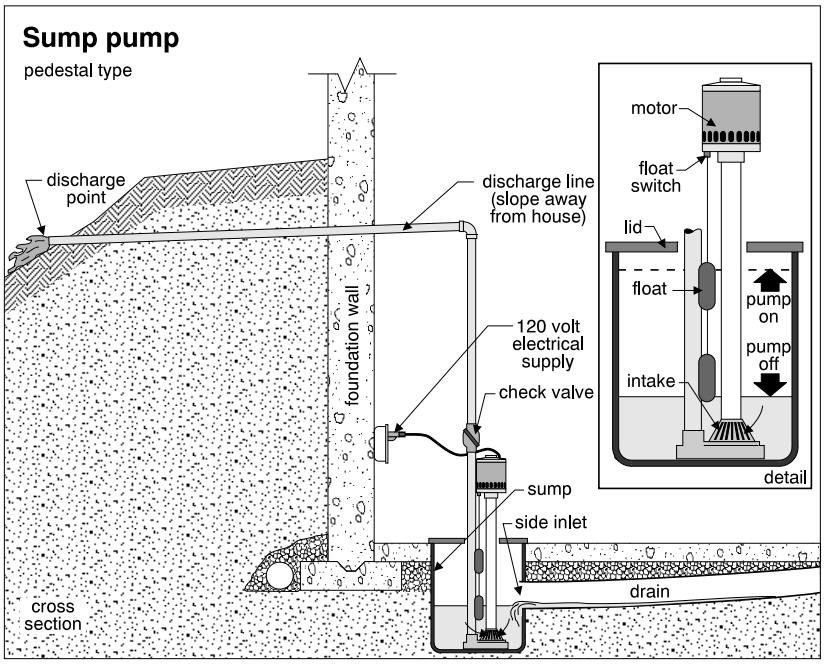
Problems

Problems can develop with the electrical supply, or the electric motor. The pump can become obstructed or damaged. Leaks can develop in the holding tank, or the connections. Clogs can develop in the piping systems which drain into or out of the tank.

Care must be taken with these systems, since raw sewage is, of course, a health hazard.

2.8 Sump Pumps: A sump pump is used to lift storm water from a low spot into a storm sewer or other discharge point, well away from the house. This electric pump is located in the sump (pit) below the basement floor level. Foundation drainage tiles or downspouts may discharge into the sump. A float switch activates the pump as the water level in the sump rises. Most systems use two floats.

The sump is a pit, typically with a concrete floor and walls. In some cases, earth walls and floors are used, although these may break down and clog the pump. There are plastic liners available intended for use in sumps.



Problems

Sump Deterioration — Problems occur if the sump deteriorates and allows debris or earth to enter the pump mechanism.

Electrical — If the electric supply to the pump is interrupted, during a power failure for example, the sump may flood. Since power failures often occur with heavy rains and storms, this can be a problem. There are pumps which can be driven by water pressure from the supply plumbing system, although these are not common and in some areas, are not permitted by plumbing authorities.

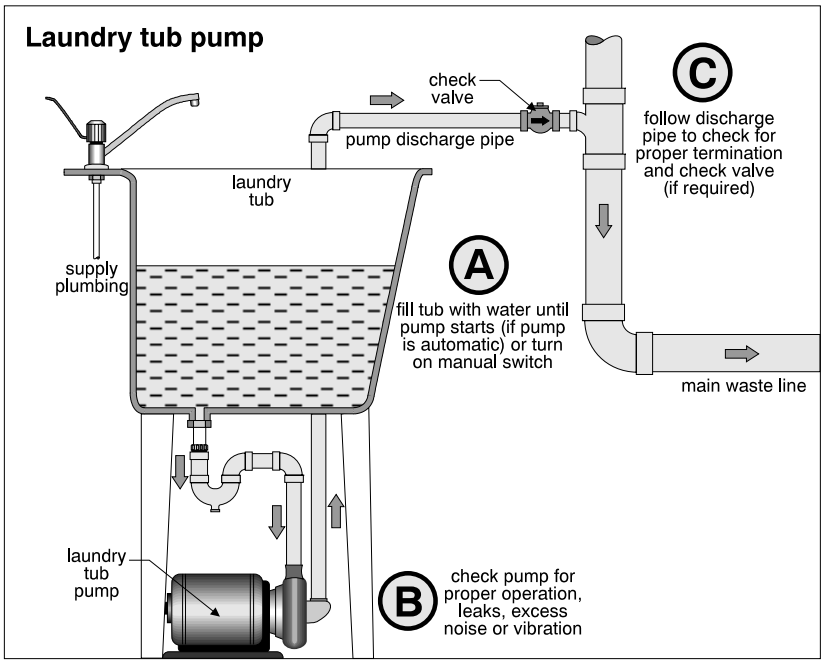
Pump and Motor — The pump mechanism or electric motor may become defective. Since the pumps are relatively inexpensive and easy to install, many people keep a spare pump on hand in case of failure. This, of course, will be a function of how critical the sump operation is. In many cases the sump operates only a few days per year; in other situations the pump may operate almost continuously.

Floats — Problems with the float system that controls the pump are very common. These are inexpensive to replace and adjust, but regular maintenance and inspection should include testing to verify that they are not entangled with the pump, the sump wall, or any foreign objects.

Discharge Pipe — The discharge piping for the pump is often a source of leakage. The piping is typically plastic which can easily be crimped or suffer from poor connections at joints. In severe cases, the discharge may be completely obstructed by a badly crimped line.

It is often difficult to find the discharge point of the piping. It may discharge into a city sewer system, a storm ditch at the front of the property, a French drain (a buried gravel pit designed to allow water to accumulate quickly and dissipate slowly by soaking into the soil), or simply onto the ground, several feet from the house. On a sloping lot, where the ground slopes down away from the house, this may be appropriate. In other cases, it can be a problem. Water in the discharge pipe may freeze if it does not have a good slope or is not well buried.

2.9 Laundry Tub Pumps: Where a laundry tub cannot drain by gravity into a waste system, a pump is usually provided below the tubs. This electrically powered pump carries water from the laundry tubs up into an appropriate waste system. This may discharge into a municipal sewer, a septic system, or a dry well. Different municipalities have different restrictions with respect to gray water (house waste water which does not contain human waste).



Some pumps have an automatic control (typically a float system within the tub), although many are manually operated by a wall switch. The laundry tub is typically large enough to hold the water from a complete cycle of a washing machine. When the washing machine cycle is completed, the pump is turned on briefly to drain the laundry tub. Either arrangement is satisfactory.

Problems:

Problems can occur with the electric supply to the pump, to the pump motor, or to the pump itself. The float system or manual switch can be defective and the pipe carrying the water away can be leaking, crimped, or obstructed. Discharge pipes outside should have a slope so that water does not accumulate in the pipes. Where the pipe is not deeply buried and water can accumulate, it may freeze up in the winter. Manually operated pumps may have the motor burned out if left running with no water in the tub.

2.10 Inappropriate/Low Quality Materials: Many materials used for waste plumbing were not intended for this use, and may be expected to have a short and troublesome life. These materials include rubber hoses, garden hoses, and non-approved plastic piping. Connections made with the wrong materials or wrong devices cannot be expected to perform properly. Special connectors are provided for special types of piping.

Inappropriate materials raises questions about workmanship throughout the system. Traps and vents are commonly omitted on amateurish installations.

► 3.0 FIXTURES

3.1 Sinks: A sink is defined as a fixture used for cleaning things, rather than people. A basin, on the other hand, is used for personal washing. We refer to a kitchen "sink", but to a bathroom "basin" or "lavatory".

Sinks may be stainless steel, enamelled steel, enamelled cast iron, copper, porcelain, plastic, etc. None of these materials is indestructible, and all have their advantages and disadvantages. Some codes do not permit sinks made of wood, concrete or tile.

A sink which includes an integral countertop platform at the back, on which the faucets sit, is generally considered superior to a sink without such a platform. Since all faucets ultimately leak, the leakage is onto the sink platform, rather than directly onto the counter top. The damage is often prevented or less serious with the platform arrangement.

Leakage and Overflow

Leakage may be the result of a cracked or rusted sink, or a poor drain connection. Most kitchen sinks do not have overflows, so the sink cannot be left unattended while filling. Some codes do not allow overflows on kitchen sinks, for fear of trapped food particles accumulating in the overflow.

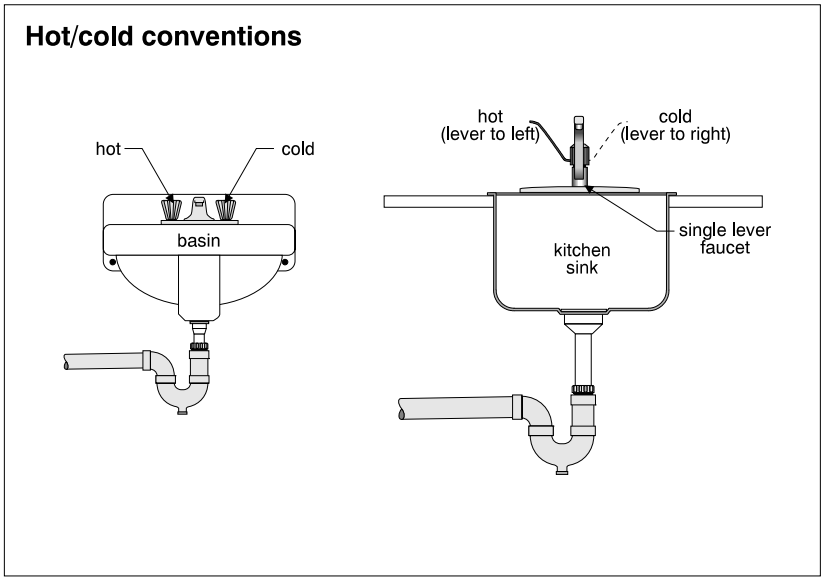
Sinks which are poorly secured will be prone to leakage, and faucets not well anchored to their sinks will also leak eventually. Sinks may rust or crack over time.

Cross Connection

Cross connections with sinks are possible. Please refer to the discussion of Cross Connections in 1.4.7 in this section.

Airgap Fittings

In some areas, approved airgap fittings are required on the discharge from a dishwasher. This is typically a chrome fitting which projects roughly three inches above the counter top adjacent to the kitchen sink. Waste water from the dishwasher travels up to the airgap fitting and back down through another line into a food waste disposal or drainage piping. The flood level of the fitting must be above the rim of the kitchen sink and the kitchen counter top. This fitting prevents water or other waste from flowing back into a dishwasher. If water discharges from the airgap fitting during dishwasher use, service is required.



3.2 Basins (Lavatories): Basins, typically located in washrooms or bathrooms, may be made of stainless steel, enameled steel, enameled cast iron, copper, vitreous china, plastic, marble, simulated marble, etc. None of these materials will last forever, and all have their strengths and weaknesses.

Leakage and Overflow

Problems which are most common include leakage and overflowing. Most bathroom basins, but not all, contain overflows. Where there is no overflow, the basin cannot be left unattended while filling.

Rust

Many enamelled steel sinks have a welded steel overflow which is a common spot for rusting to occur. This rusting, visible from the underside of the sink, will eventually result in leakage and can appear just a few years into the life of the sink. Some post 1990 sinks rely on a siliconed joint rather than a welded seam. This may prove more durable.

Cracks

Cracking of cultured marble sinks around the drain connection is common. This does not normally lead to leakage in the short term, but is unsightly. Ultimately the basin has to be replaced. While the cause of this problem is disputed, it is suspected to be related to the pressure exerted by the expansion of the metal drainage components when exposed to hot water.

Cross connections with basins are possible, although not common. Please refer to the discussion of Cross Connections earlier in this section. (See Section 1.4.7)

Leakage

3.3 Faucets: There are several different types and styles of faucets with a wide range of qualities available. The traditional compression faucet employs a disk washer to shut off the water, when the washer is turned down against a seat. Leakage out through the faucet usually indicates a deteriorated washer. Leakage around the handle of a faucet usually indicates deteriorated packing. Both of these problems require minor repairs, and leaking packing is considered to be a greater threat than a leaking washer. A leaking washer will only allow water to run into the fixture, while leaking packing will allow water to run onto a counter top, for example.

Some modern faucets use a cartridge, valve, or ball to direct water flow. Single lever faucets have become common for sink, basin and bathtub use. These mixing valves allow the control of hot water, cold water and volume with a single handle.

There are sophisticated faucets available for showers, which will maintain the temperature selected, irrespective of pressure changes in the system. For example, if someone is having a shower, and two other cold water fixtures in the house are turned on, the cold water pressure to the shower will decrease. The person using an ordinary faucet may be scalded by the hot water which comes out of the shower head. The pressure sensitive mixing valve will adjust to this automatically, reducing the pressure on the hot water system to match the cold. Consequently, the volume of water available drops off significantly but the temperature remains the same. This is a much safer situation.

Damaged

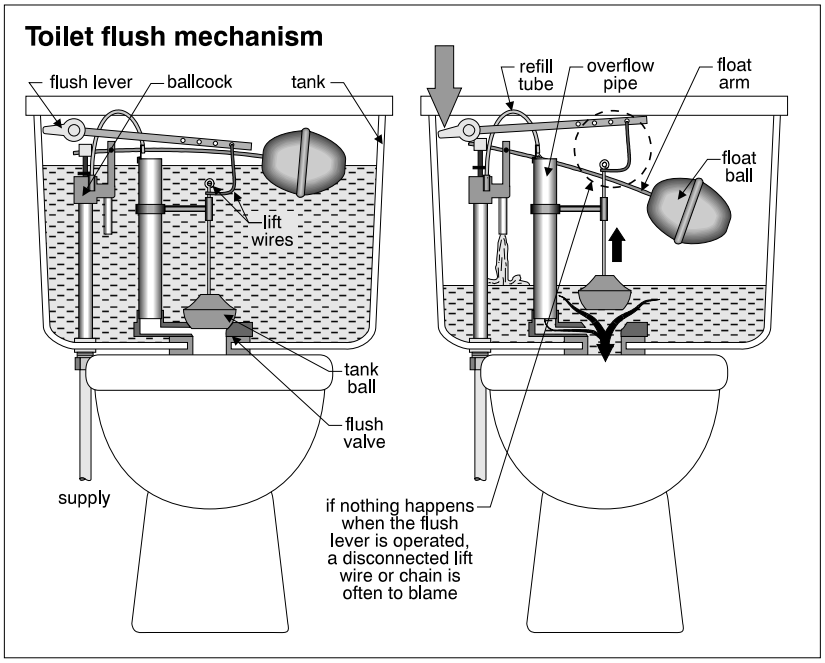
Irrespective of the faucet type, leakage and difficulty in operating the valve are the two most common problems. Damaged faucet handles may be dangerous, if there are jagged edges. Where there is the possibility of someone cutting their hand using a faucet, the handle or entire faucet should be replaced as necessary.

Loose

It is common for faucet sets not to be well secured to the wall, counter top or fixture. This is a minor problem, although it can be difficult to access. If not corrected, it may result in leakage.

Faucets have moving parts and do require maintenance. Unfortunately, there is no regular preventative maintenance that is practical, and no easy way to predict leaks.

3.4 Toilets (Water Closets, Commodes, Hoppers): Most toilets are made of vitreous china, although other materials are occasionally used. There are several different styles of toilets and several different flush mechanisms. Some of the older toilets have relatively weak flush mechanisms and are more prone to clogging. Some toilets have a tank which is integral, although most toilets and tanks are two separate components.



Washdown The old washdown toilet, identified by its large bulge on the front of the bowl, is a relatively poor toilet, with a very small wetted area inside the bowl. A large part of the bowl is nearly horizontal. This toilet type is no longer commonly available and is not allowed by some municipalities.

Reverse Trap and Siphon Jet The reverse trap toilet is better, although somewhat noisy. A good wetted area is presented in the bowl. The siphon jet is an improved reverse trap; quieter and with a very good wetted area.

Siphon Action The one-piece toilets are typically very expensive and very quiet. They are called siphon action and almost all the bowl surface areas are covered with water. The flush action can be somewhat lazy in these toilets.

Leakage Problems can occur with leakage at the toilet supply line, at the storage tank, at the connection between the tank and the bowl, at the bowl itself (e.g. if the bowl is cracked), or at the connection between the toilet bottom and the drain pipe.

Loose Toilets are often poorly secured to the floor system. This can result in leakage at the base of the toilet over the long term. It is usually easy to secure a loose toilet.

Inoperative or Continuously Running

If a toilet does not flush at all, there is usually no water in the tank. The problem is one of supply water to the tank. If the toilet runs continuously, this means there is leakage from the tank into the bowl. While this will not cause any water damage, per se, a continuously running cold water pipe bringing water into the toilet, and a continuously running drain may lead to condensation problems on the outside of these pipes, particularly during warm humid weather. The resulting water damage can be significant. A continuously running toilet also wastes a good deal of water. Repairs to the flush mechanism are called for in this situation. The flush mechanism is a relatively complicated mechanical device and problems may develop with the float, rod, plunger, ball cock, filler tube, refill tube, trip lever, tank ball, etc. These are typically inexpensive repairs.

Slow Flush

Slow flushing toilets are usually partially obstructed. In some cases, a plunger will clear the obstruction; in others, a plumber's snake is necessary. Occasionally, the toilet has to be temporarily removed to get at the problem.

Seat

Problems with the toilet seat are not functional from a plumbing standpoint. Seats can usually be replaced readily.

3.5 Bathtubs: Bathtubs may be free standing or built in, and may be enamelled cast iron, enamelled steel, fiber glass, plastic, etc. Custom bathtubs can be made of tile, marble or copper, just to name a few. Bathtubs are susceptible to chipped enamel, rusting, and leakage through supply or drain connections.

Overflow Connection

Bathtub overflows are a common source of leakage. Since they are not used on a regular basis, they are often installed poorly with the potential for leakage. When the bathtub does overflow in an emergency, water may escape around the overflow connection. This is impossible to predict from a visual inspection.

Tub/Tile Intersection

When leakage is noted on a ceiling below a bathroom, the source is usually the bathtub area. In many cases, however, the leakage is not the fault of the bathtub, per se, but of the connection between the tub and tile enclosure. Conventional bathtubs have a one inch lip around the top of the tub, on the side and ends that go against the wall. When the wall is finished, the lip cannot be seen, since it goes up behind the ceramic tile. This lip is intended to minimize leakage at the tub/tile intersection. Early signs of a problem may be loose ceramic tiles.

Some bathtubs are designed to be free standing (away from the walls). These tubs do not contemplate the installation of a shower. Where these tubs are used with a conventional bathtub enclosure and a shower, they may be very susceptible to leakage around the edges. These tubs do not have the one inch lip around the outside of the tub shelf

Slope

The bathtub must be installed so water in the tub will flow naturally to the drain, and so that water that lands on the shelf around the perimeter of the tub will run into, not out of the tub. Spillage or splashing can defeat the best sloped installations.

Reglazing

Reglazing old bathtubs is a relatively new process. The advantage of this is that it can be done in place, and is much less expensive than replacing a tub. The results, however, do not seem to be long lasting and, if considering this, it may be wise to enquire about the life expectancy of the new finish.

The older cast iron bathtubs are credited with keeping the water hotter than the modern tubs, although this is not a matter of great import. Some builders provide fiber glass insulation around modern steel tubs, as a way of keeping the water hot.

3.6 Bathtub Enclosure: Bathtub enclosures may be ceramic tile, plastic, marble tile, simulated marble tile, glass tile, plastic tile or plastic laminates. All of these materials, if properly installed, are considered acceptable. Modern one piece acrylic or fiber glass enclosures are also considered effective if properly installed. Wood enclosures and hardboard materials with a simulated tile finish are not considered good long term materials, where a shower is to be used.

Tiles in Concrete

In houses built in the first sixty years of this century, it is common to find ceramic tiles set in concrete ("set in mud" is the tiler's term). This is a very good installation method and the life of the tile system can be fifty years or more. This system, however, is expensive to remove when demolition is necessary.

Tiles Glued On

Modern tile application typically uses an adhesive which bonds the tile to plaster, drywall, plywood or a lightweight concrete board. This method of securing tiles is less desirable since the adhesive can be weakened as water gets in behind the tile. Perhaps more importantly, concealed wall surfaces such as plaster, drywall or wood will also be damaged by the water.

Drywall Behind Tiles

Where drywall is used in a bathtub or shower stall enclosure behind the tile, it should be a special water resistant type (green drywall). This is not waterproof drywall, but does afford some protection against moisture.

Grout and Caulk

Water penetrates a tile enclosure two ways, typically. Openings in grout joints or poor grout mixes will allow water to pass through during showers. Secondly, the connection between the tile and the tub is a weak spot. No matter what quality caulking is used, over a period of time, an opening will develop between the tub and tile. Although there is a lip on the tub going up about one inch behind the tile, this does not prevent water damage. Since bathtubs will flex to some degree, when filled with water and a person, this movement contributes to deterioration of the caulking. Many tile experts recommend that when caulking a tub, the tub be filled with water and at least one person be in the tub.

Leaks Around Tile Openings

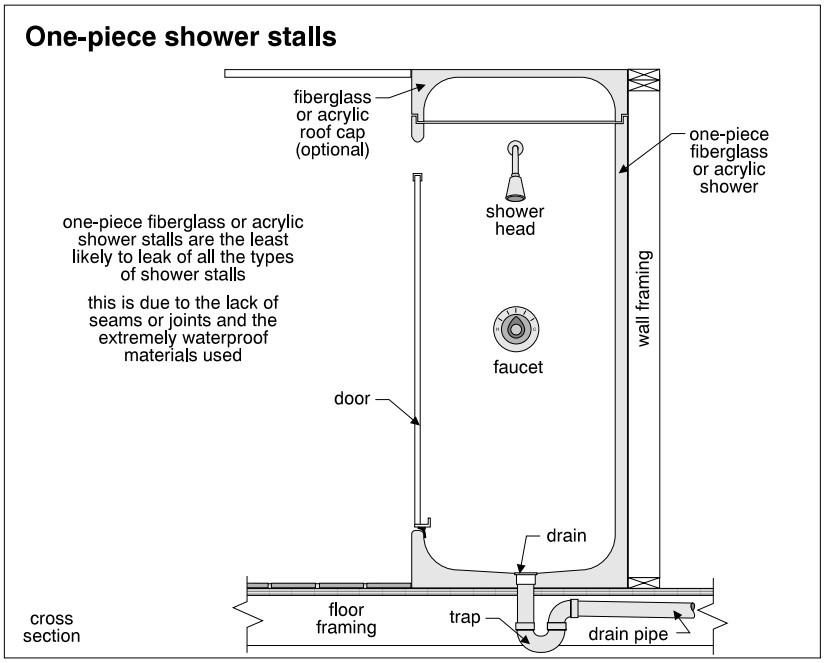
Leakage can occur in the bathtub enclosure through openings created for faucets, spouts and soap dishes, for example.

Loose Tile

When the tile is loose or buckling, the tile must be removed, and in many cases the support material (plaster, drywall or plywood) must also be replaced. The new low density concrete boards are better than drywall or plywood in terms of rigidity and resistance to moisture.

Windows Windows above bathtubs can be a problem where there is a shower. This was a common window location in the first half of the twentieth century, before showers were common. A window may be damaged by rot over the long term if not protected from shower water accumulation. Where a window is in place, it should at least be protected by a waterproof curtain. Interior window sills should be avoided as much as possible, as should any other horizontal ledges which allow water to collect.

3.7 Shower Stalls: Traditionally, shower stalls were made of ceramic tile, glass or marble tile. Modern one, two or three piece shower stalls in fiber glass or acrylic are popular. Some of these are quite good quality. One of the problems with fiber glass and acrylic is that abrasive cleansers will scratch the surface, making it almost impossible to clean.



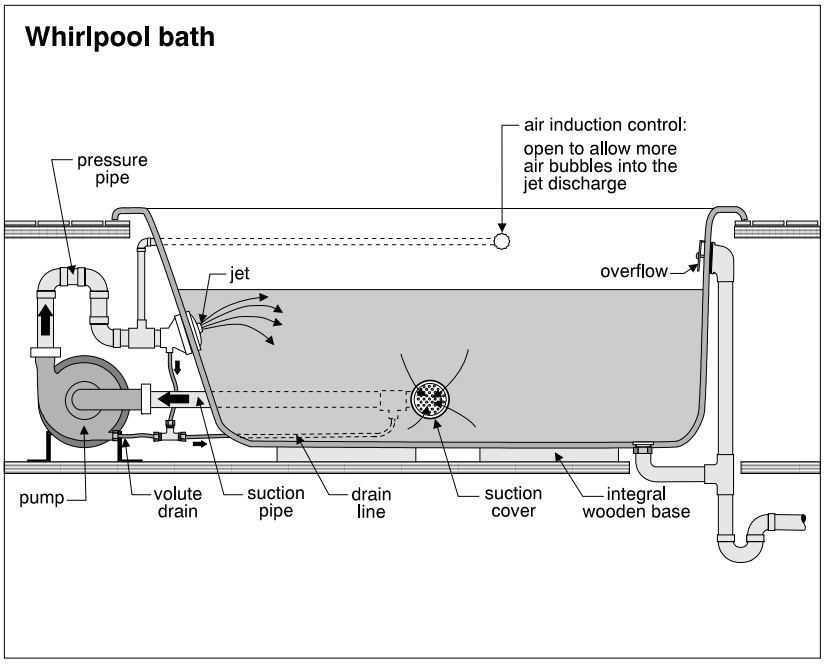
Metal Metal shower stalls are typically low quality and are prone to rusting around the bottom within the first few years.

Tile Leakage Shower stalls are notorious for leakage through the tilework. Since there is a great deal of tilework in traditional shower stalls (all walls and the floor typically), any small openings in the grout or caulking may cause problems. Because shower stalls are often poorly lit, small tile flaws often go unnoticed until damage appears below. Leakage through the faucet and soap dish joints is common.

Bottom Pan The construction of the tile shower stall includes a lead (traditional) or neoprene (modern) pan around the bottom of the stall. This one piece pan below the tile typically extends up about six inches above the bottom of the shower floor, on all four sides. This pan will catch minor leakage, although if it is not well secured around the drain, leakage will develop here. In the event of a serious leak, this pan will not be effective. Tile shower stalls are very expensive to rebuild, and are sometimes replaced with fiber glass or plastic shower stalls.

Weight

3.8 Whirlpool Baths: A whirlpool bath is essentially a conventional bathtub with a circulating pump, supply jets and a return intake added. Whirlpool baths can be very large, and contain a great deal of water when filled. In some cases, engineering consideration to the floor structure below should be given.



A conventional residential floor system is designed for thirty to forty pounds per square foot of live load. Typical floor loads imposed by whirlpools range from forty to sixty pounds per square foot. A visual inspection will not reveal the framing details below a whirlpool in most circumstances. Sometimes, evidence of deflection below the tub can be seen.

GFCI

The electric supply to the whirlpool should be protected by a ground fault circuit interrupter. This is a special, highly sensitive device which will shut off the electricity in the event of a very small electrical fault. This additional safety is important, of course, wherever water and electricity come together.

Pump and Motor

Problems may develop with the electric motor or the pump mechanism. Leaks or obstructions in the piping lines around the tub can appear, and may be difficult to access and repair. Connection points of the piping to the tub may be potential leakage areas as well.

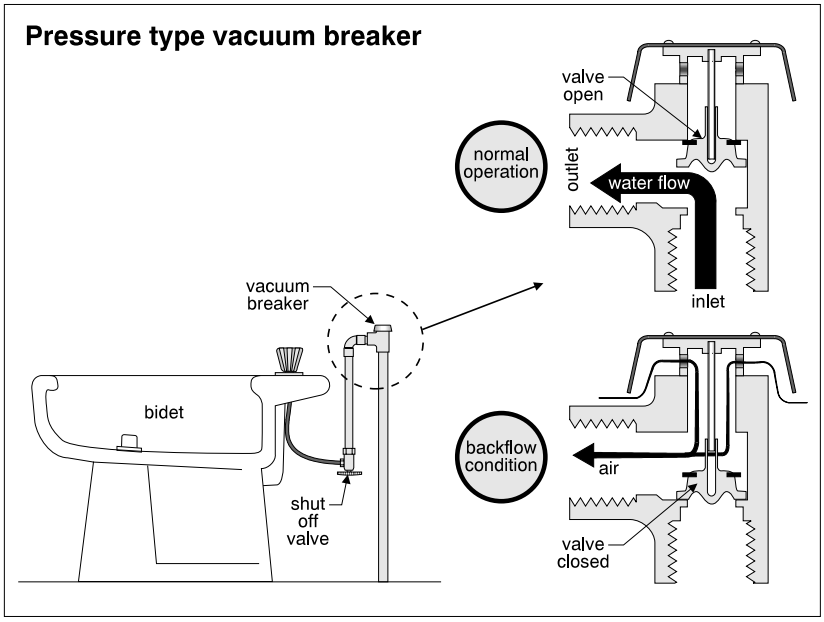
Controls

The electrical control for the whirlpool should be located at least three feet from the tub. Many codes also require that the switch be a timer. There is a danger of people staying in the whirlpool for long periods of time. As a result, the whirlpool should only be able to be turned on for a fixed number of minutes. Some tubs have an air (pneumatic) switch with a timer right on the tub.

Service Access It is good practice to provide a readily accessible service door to work on the pump and motor. Where this is not available, repairs will be more expensive.

Larger Water Heater Larger whirlpools may require larger water heaters to ensure the tub can be filled with hot water. Some manufacturers recommend water temperatures not exceed 104°F, to avoid discoloration of the acrylic.

3.9 Bidets: Bidets are complex plumbing fixtures which are susceptible to cross connections. As a result, a vacuum breaker is provided at the supply piping connection to a bidet. This prevents waste water from flowing back into the supply water. Most bidets are china, and are subject to cracking or leakage. In areas of hard water, the small jets of a bidet can become clogged. Control valves and diverters may leak or break.



3.10 Saunas: A sauna room should be an insulated wooden structure. There should be no exposed metal components such as door hinges or handles in a sauna, for fear of burning someone who touches the metal component. A sauna may have a water faucet in it, in which case it should have a floor drain as well; however, it is not unusual to see a sauna with a supply faucet but no floor drain.

The electric sauna heater should have an outside control and should be specifically approved as a heater for a sauna room. The name plate sets out minimum clearances to combustibles, and these should be observed. The sauna heater should be securely fastened. It is not permitted to provide a shower or water spray device immediately above a sauna heater.

Due to the temperatures generated, electrical components in a sauna area (overhead light fixtures, for example) should be carefully arranged so that heat dissipation is not a problem.

Discharge Outside

3.11 Bathroom Fans: Bathroom fans are required by most codes where a bathroom does not have an operable window. The fan should discharge directly to the building exterior. In many cases, the fan terminates inside the house or roof space. This can add considerable moisture to a house, leading to condensation and rot problems.

Fans Desirable

Although fans are not required in bathrooms with operable windows, they are desirable in these rooms. In the winter months, one is not likely to open a window to dissipate the steam generated by a shower. This heavy concentration of moisture, particularly in a bathroom where showers are used regularly, can lead to premature failure of interior finishes such as paint and wallpaper, and result in mildew and rot in concealed areas.

Noisy

Bathroom fans are notoriously noisy. This is particularly true of lower quality fans. The fan may be operated by a separate switch, or by the room light switch. Some fan switches are on timers, and others are on rheostats (so the speed can be varied). Neither of these is considered particularly important.

Inoperative

Many bathroom fans are inoperative, because the motor or fan mechanism has failed. Often, the fan has simply been disconnected by a homeowner, irritated by the noise.

Capacity

The exhaust fan should provide at least twelve air changes per hour. For example, in a bathroom that is five feet by eight feet by eight feet high, the exhaust fan should have a capability of more than sixty-four cfm (cubic feet per minute).

Attics and Chimneys

Where the exhaust fan ductwork passes through unheated spaces such as attics, it should be insulated to prevent condensation. Exhaust fans should never discharge into chimneys.

3.12 Kitchen Fans: The kitchen fan may discharge directly to the building exterior, or may simply recirculate the air into the kitchen after passing it through a charcoal filter. Even fans which discharge to the building exterior typically have some sort of filter. In either case, the filters should be cleaned and/or replaced, following the manufacturer's recommendations. The hood-type kitchen fans are the most common provided today.

Older Style

Older kitchen exhaust fans are located directly in the exterior wall, and were often activated by opening the cover of the fan. These fans are typically good quality and although older, do provide effective exhaust ventilation.

Attics and Chimneys

Exhaust fan ductwork which passes through unheated areas such as attics should be insulated to prevent condensation. Kitchen fans should never discharge into chimneys.

Down-Draft

Some cook tops have built in fans with down draft, which exhaust air from the cook top area. On some appliances, these fans are of modest capacity, and where the exhaust ductwork to the exterior has to be lengthy or contains several bends, the fan performance may be weak.

Inoperative

An inoperative kitchen fan is usually the result of an interruption in the electrical supply, or failure of the electric motor. On occasion, the fan itself can be jammed or the bearings may have failed.

3.13 Outdoor Faucets: Outdoor faucets are conventional cold water supply valves, typically. During the winter months, the water supply should be shut off by another valve in the building interior. The outside valve is typically left open to allow any water in the pipe to escape. The inside winter shut off valve may be provided with an auxiliary bleed valve to allow any water between the two valves to escape.

Many codes now require backflow preventers on outdoor faucets to protect against cross connections. See section 1.4.7.

Frost-proof Special frost-proof valves provided on the building exterior do not require any interior shut-off in the winter. These valves have a long stem which penetrates through the building wall and effectively shuts off the water supply inside the building. These valves should be sloped to drain. They are, of course, more expensive.

Leakage and Damage Outdoor faucets are susceptible to washer and packing failure and resultant leakage. They are also more vulnerable to mechanical damage than inside valves. Because of their exposure to extremes of weather, it is possible for the valves to become inoperative. Replacement of these is not a major expense.

3.14 Laundry Tubs: The traditional concrete laundry tubs have been replaced, for the most part, recently by steel and plastic tubs. The concrete tubs although durable, are heavy and ultimately are prone to cracking. Where the old tubs are leaking, they can be patched, although usually they will soon develop more cracks. Replacing the tubs is not expensive. Removing the heavy concrete tubs is difficult, without breaking up the tubs. Where concrete laundry tubs are present, the waste plumbing is often lead. This lead waste plumbing is usually replaced with ABS plastic pipe when the tubs are replaced.

Cross Connections Older laundry tubs may be subject to cross connections. It should be ensured that the faucet set is installed above the laundry tub, so that there is no possibility of the faucet itself becoming submerged when the tub is full. Refer to the discussion of Cross Connections in this section. (See Section 1.4.7)

► 4.0 GAS PIPING

Houses which are supplied with gas have piping which runs underground to the house and then into the building. Depending on the local jurisdiction, gas shut off valves outside the building above grade are usually required on new installations.

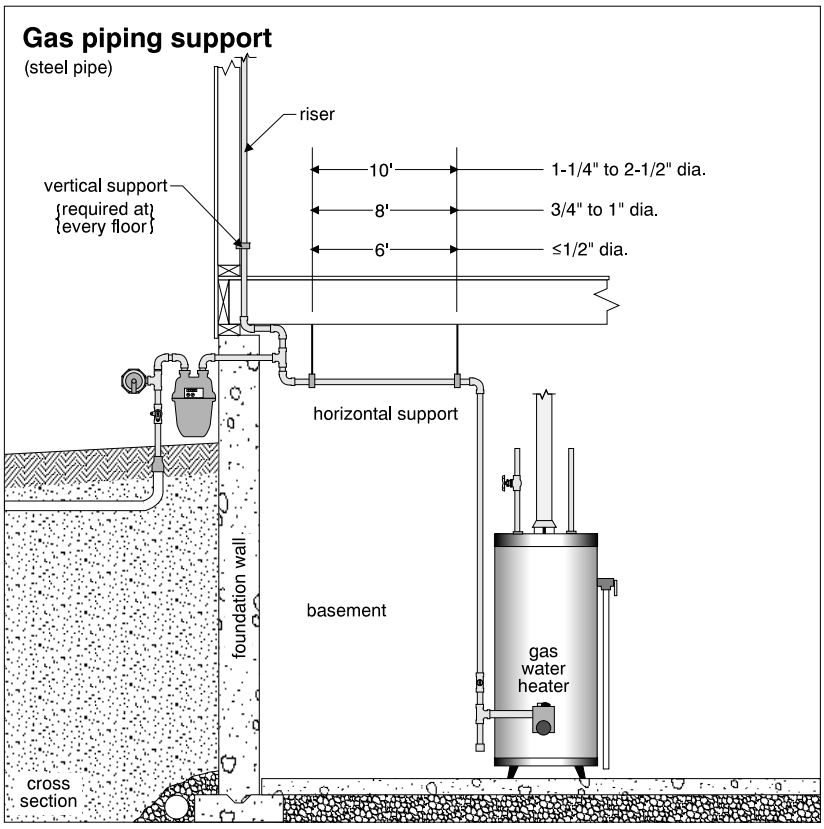
Materials Gas piping indoors should be either iron or steel, yellow brass or copper. In some jurisdictions, copper is not permitted. Outdoor underground piping can be plastic.

Underground Piping Where iron or steel piping is used underground, it should be protected from rusting with coatings or wraps which cover the pipe underground and up to a point six inches above grade. Some areas also require cathodic protection (letting a sacrifice material rust to protect the gas piping).

Where plastic pipe is used underground, metal risers or chases should come up above grade. The plastic piping should not be visible or exposed to mechanical damage. A copper tracer wire is laid around the pipe to help the gas company find it later, when someone wants to dig in the area. The wire should be visible on the above grade section of the pipe.

Pipe Support

Piping should be well supported, and there should be no strain on the gas piping. The gas piping should not be used to support appliances.



Appliance Connections

Where appliances are connected, there should be a shut off valve in the same room for each appliance, as close to the appliance as is practical. Unions or swing joints should not be in concealed areas (walls, attic, et cetera).

In Canada, furnaces, boilers and water heaters must be connected directly to the piping. In the U.S., appliance connectors (flexible metal piping) can be used in some areas. The direct connection is considered superior, except perhaps, in areas where earthquake is a concern. Connectors, for the most part, should be three feet long, although range or dryer connectors can be six feet long. The connectors should not pass through walls, floors or ceilings, and should be immediately preceded by shut off valve. Aluminum connectors are permitted if they are not exposed to water, masonry, plaster or insulation. Gas hoses are not allowed indoors.

Where there are gas outlets for barbecues or fireplaces, the valves should be outside the hearth within four feet of the appliance, in the same room as the appliance.

Grounding Gas piping should not be used for the grounding of electrical systems, however, in some jurisdictions, gas piping is bonded to supply piping (usually at the water heater) if the supply piping is grounded.

Leaks Any gas leak is a potentially life threatening situation. If a leak is noted, all occupants should leave the house immediately and contact the gas company from a neighbor's house. No switches, telephones, door bells, or anything else which might cause a spark should be operated.

Drip Legs Many jurisdictions require a vertical pipe extension (drip leg) below the elbow where the horizontal pipe feeds an appliance. Any foreign material in the gas coming toward the appliance will drop into the drip leg, rather than turn and head into the burner.

► NOTES