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# evaluating plumbing systems in older minnesota homes



Prepared by:

— William J. Angell, extension housing specialist, Agricultural Extension Service, University of Minnesota

In cooperation with:

— Douglas Schwab, senior plumbing inspector, St. Paul Inspections Division  
— Kenneth Jensen, assistant plumbing supervisor, Minneapolis Department of Inspections

Home plumbing is essential for the comfort and health of the family. A deficient system is a threat to health and expensive to correct. Therefore, buyers and remodelers of older homes should become familiar with the main elements of a plumbing system and should understand how a system works.

Evaluating a plumbing system is not difficult. It is one of the easiest steps in evaluating an older home if you learn a few basics. The following information will help you to determine if serious defects are present in a plumbing system and what alternatives exist. If additional help is needed, consult a licensed and bonded plumbing contractor or a local plumbing inspector. Most plumbing inspectors have schedules that do not allow teaching homeowners how to do plumbing. Anyone who wants this training should contact a vocational school.

Before making any change in plumbing, it is desirable, and usually legally required, to obtain a permit from your community or county government. The permit requires that plumbing work meet the minimum safety standards of the Minnesota Plumbing Code. Since the code is based upon accepted good plumbing practices, remodelers will want, as well as be required, to follow the code. This will help them install a good plumbing system that is more likely to pass the final inspection for safety. Remember, for one's own health and safety, all plumbing work, including water heater replacement, should be done only after getting a permit.

## HOW A PLUMBING SYSTEM OPERATES

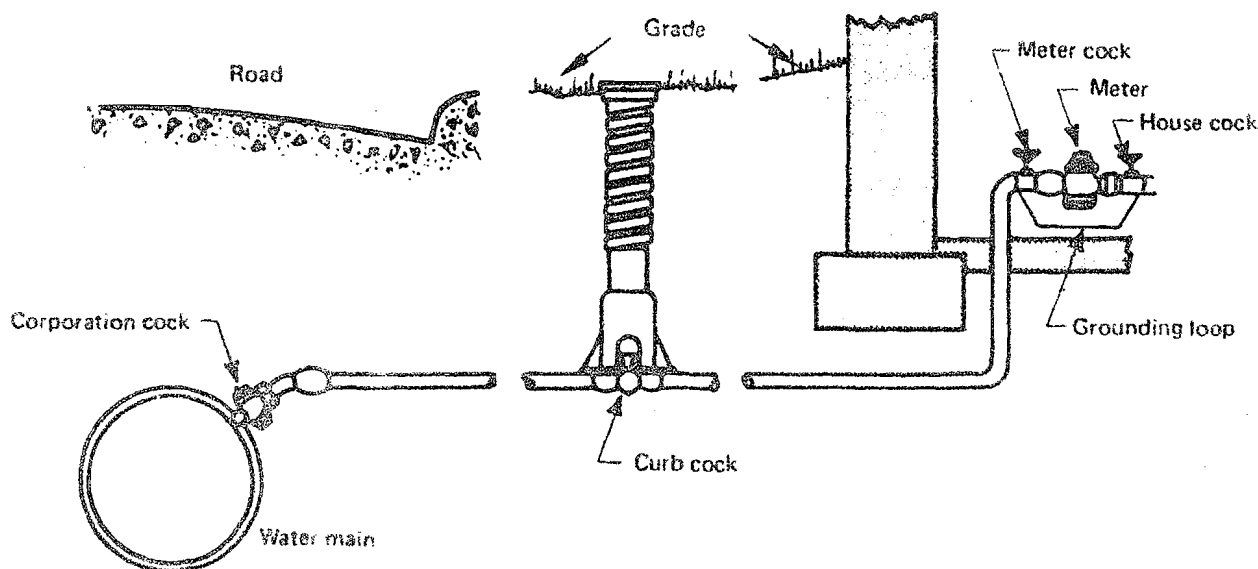
A properly designed and installed plumbing system consists of three basic parts: 1) the water supply system which delivers fresh water from municipal mains or the individual's private well, 2) the drainage system which discharges waste to the municipal sewer or the individual's septic tank and which vents dangerous gases and prevents back siphoning of polluted water into the fresh water system, and 3) fixtures including sill cocks, dishwashers, sinks, clothes washers, bathtubs, shower heads, toilets, and garbage disposals or grinders.

### WATER SUPPLY SYSTEM

The primary function of the water supply system is to furnish an adequate quantity of safe, hot and cold water at an adequate pressure. The water supply system begins with connection to either a municipal water main through a corporation cock. The service line then passes underground through a curb cock which is a valve used to turn off water service for emergency repairs, such as basement flooding. After entering the home, a meter cock or valve is generally provided on the service line to shut off the meter for repair. The service line then passes through the meter. Because the home's wiring system usually is grounded to the water service line, a grounding loop may be installed around the meter. Common deficiencies in older houses' water service include:

- inadequate water pressure or inadequate volume caused by corroded service lines. Replacement in-

Diagram 1. Municipal Water Connection



volves digging up the existing line and replacing it. This may cost several hundred dollars depending on the line's depth and length.

- service lines that freeze in winter because they are not at least 7 feet below the ground. To correct this problem, the line may need to be replaced and buried lower.
- absence of a meter cock or a worn, ineffective meter cock.
- rusted, galvanized iron nipples (pipe) between the meter cock and meter.

### Private Water Service<sup>1</sup>

In areas without a community water system, the buyer of an older home usually will find a drilled well with pump, pressure tank, and perhaps water treatment equipment. The water quality for potability (safe for drinking) should always be tested. The Minnesota Department of Health (717 Delaware St. S.E., Minneapolis, MN 55414) provides sampling kits and tests for potability free of charge. A simple taste test will tell you if the water is palatable (acceptable in taste, smell, and appearance). If you suspect that the water contains personally unacceptable amounts of minerals (e.g., iron causing rusty stains in bathtubs, toilets, sinks, clothes, or water; calcium or magnesium, "hard water" causing lime deposits inside faucets, scum on water after using soap, or graying clothes; etc.), you may want to contact an independent water testing laboratory for further testing. A testing laboratory can recommend methods to correct mineral problems. In addition to water tests, the home buyer should check several other items in a private water system:

- the top of the well casing should be covered (with a seal, cap, or pump mounting) so that insects and other foreign matter cannot enter the well. For new wells, homeowners should hire only licensed well drilling contractors and insist that the contract specify that the well be installed to conform with the state code.
- the pump's capacity for domestic home use should be at least:
  - 3 gallons per minute for a 2 bedroom, 1 bath home
  - 5 gallons per minute for a 3 bedroom, 1½ bath home
  - 7 gallons per minute for a 4 bedroom, 2 bath home

For new homes, rates twice as great are desirable.

- a minimum water pressure of 20 pounds per square inch (psi) to all fixtures should be provided by the pump. Most pressure switches controlling the pump have settings between 20 and 40 psi with pumps set between 30 and 50 psi. Higher water flow and pressure may be necessary for the proper operation of water softeners and iron filters.

### Hot and Cold Water Lines

From the water meter, pressure tank, or water conditioning equipment, water supply lines usually pass through the house cock or valve (diagram 2). The house cock should be used for repair shutoffs to reduce wear on the meter cock. The water supply line continues from the house cock through the cold water

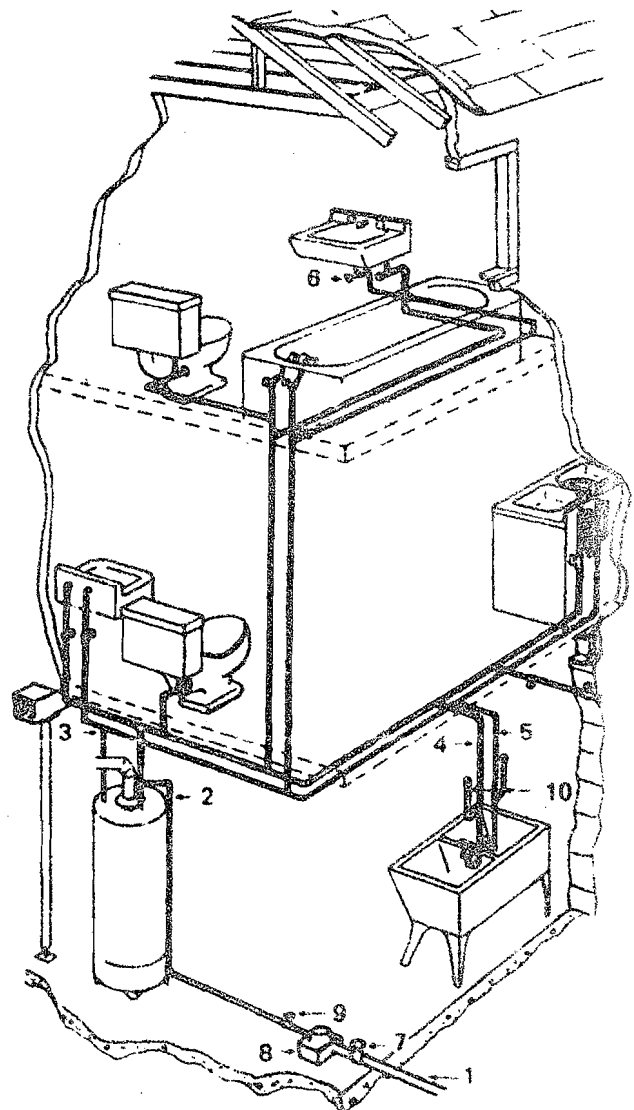


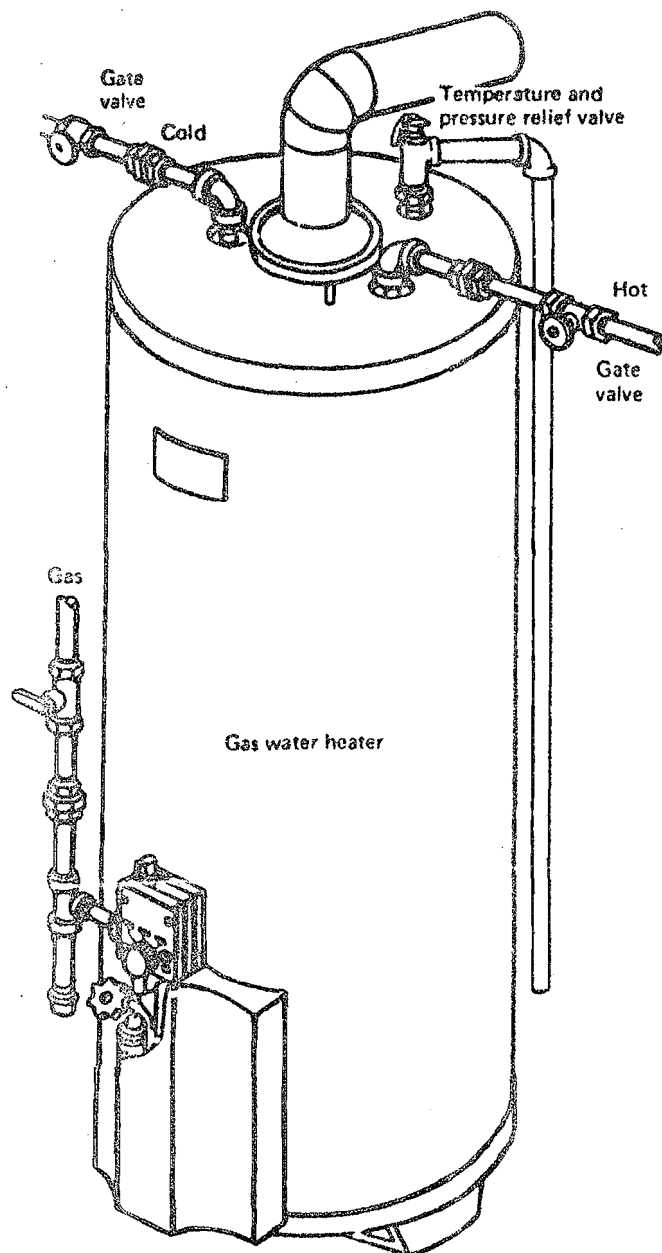
Diagram 2. Water Supply System

- |                       |                        |
|-----------------------|------------------------|
| 1 = Building main     | 6 = Valve              |
| 2 = Cold water main   | 7 = Meter cock (valve) |
| 3 = Hot water main    | 8 = Meter              |
| 4 = Cold water branch | 9 = House cock (valve) |
| 5 = Hot water branch  | 10 = Air chambers      |

<sup>1</sup>For more information about private water sources, see Private Water Systems (MWPS-14) available for \$2.60 from the Bulletin Room, 3 Coffey Hall, 1420 Eckles Avenue, University of Minnesota, St. Paul, MN 55108. If you have questions about the condition of the well pump and equipment, you may wish to check with the contractor who has installed and services these items.

main line to branch lines ending with individual fixtures. It is desirable to have shut-off valves (which function and are not frozen shut) on all branch lines so individual fixtures and sill cocks may be isolated for repair or replacement. Furthermore, air chambers are desirable on all branch lines leading to faucets to reduce or eliminate water hammering.

Diagram 3. Gas Water Heater



- Notes:
1. Class B gas vent must be used when the flue passes through floors.
  2. Sidewall horizontal flues must be at least 6 inches from wood joists and studs.
  3. Temperature and pressure relief valves must be installed within 6 inches of the top of the tank and must be connected to a pipe extending within 6 to 18 inches of the floor.
  4. Gate valve on hot water line is generally considered to be an optional convenience.

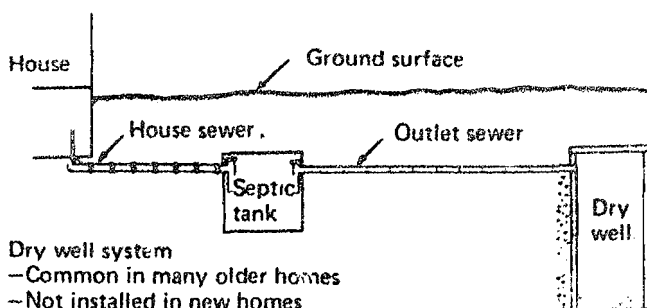
The buyer or remodeler of an older house should check carefully all main and branch lines and connections for signs of deterioration or leakage. Special attention is to be given to galvanized pipe which corrodes easier than brass or copper. (Check for galvanized pipe with a magnet.) Check to see that pressure is adequate at all fixtures when galvanized pipe is used because galvanized pipe is more susceptible to mineral build-up. In copper and brass pipe also mineral deposits coat the inside of the pipe eventually blocking flow completely and necessitating replacement. Note: The Minnesota Plumbing Code does not currently allow plastic pipe to be used for water supply lines.

### Hot Water Heater

Water is heated by circulating cold water through a water heater. In some older homes, the water heater may be part of the central heating plant with an attached hot-water storage tank and furnace coil. In new or replacement situations, however, a separate gas, electric, or oil water heater will be found (diagram 3). To evaluate the water heater, consider the following:

- The normal life of a water heater is 10 to 15 years, less in areas with hard water and more when a corrosion-resistant tank such as glass is used. (Check the specification plate.)
- A temperature and pressure relief valve is absolutely necessary (and legally required by the state plumbing code) on all hot water heaters and storage tanks.
- Shut-off valves are necessary on the cold water supply line to the water heater.
- To determine whether the water heater supplies an adequate amount of hot water, check the specification plate for recovery rate (25.0 or higher is desirable) and capacity (generally a 30 gallon gas or oil fired or a 50 gallon electric heater is adequate).

Diagram 4. Onsite Sewage Treatment—Dry Well System



### Dry well system

- Common in many older homes
- Not installed in new homes

- Rust or leaks on the tank, especially the bottom, indicate that the tank will need replacement.
- Corroded hot or cold water lines caused by joining galvanized steel and copper pipe without a proper dielectric coupling.

## DRAINAGE SYSTEM

The function of the drainage system is to safely carry and dispose of wastes from the plumbing fixtures. The drainage system ends with a connection to either a municipal sewer or a privately owned septic tank and drain field or dry well.

### Municipal Sewer

The two most common problems found in sewer connections to municipal systems are inadequate drainage and backup. These problems may be identified by slow drainage in lower floor fixtures and water marks around floor drains. Inadequate or extremely slow drainage generally is caused by clogs resulting from root penetration. Boring out with an electric reamer remedies this problem. Backup during heavy rains usually is caused by an outdated municipal sewer system handling both sanitary wastes and storm

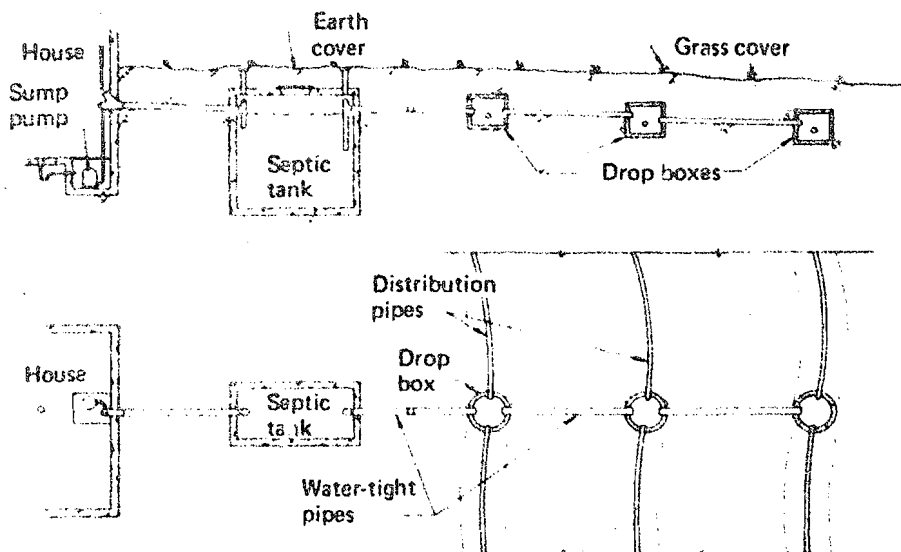
runoff. Only action by local government can correct this situation.

### Onsite Sewage Treatment<sup>2</sup>

(diagram 4). Common problems found in private sewer systems are undersized drain fields, undersized septic tanks, and poorly maintained septic tanks which cause clogged drywells or drainfields. An adequate size tank is one of the most important parts of a sewage treatment system. A 1,000-gallon septic tank is the minimum size recommended for a three bedroom home. Larger tanks are recommended for larger homes (4 bedrooms, 1,250 gallons; 5 bedrooms, 1,500 gallons; etc.). Adequate drain field size depends on soil characteristics and amount of sewage to be treated. If the ground above the drain field is especially wet or soggy or if the capacity of the tank is smaller than your needs, the sewage treatment system may be inadequate for your needs. If you suspect that a private sewage treatment system is inadequate, contact your local zoning administrator or sanitarian.

<sup>2</sup>For more information, see Town and Country Sewage Treatment (Extension Bulletin 304), by Roger E. Machmeier, Agricultural Extension Service, University of Minnesota. St. Paul, MN 55108. When buying a home with an onsite sewage treatment system, check with the individual who has installed or serviced the system. Ask about capacity, condition, and when the septic tank was last emptied (critical to proper operation).

Diagram 4 (continued). Onsite Sewage Treatment—Trench System



—Installed in new homes.

## Drainage Lines, Traps, and Vents

The waste drainage system within the house is composed of the following parts (diagram 5):

- house or building drain leading from branch drains and soil stacks to the sewer or septic tank.
- clean-out used to service the building drain to the sewer.
- soil stack serves the dual function of draining the branch drains from individual fixtures and venting dangerous sewer gases, thereby preventing back pressure through fixture traps.
- traps hold water between the fixture and drain lines to prevent dangerous sewer gases from entering. As illustrated in diagram 5, several types of drainage traps are found in older homes. "P" traps are the most common and generally found on lavatories, sinks, and other fixtures not discharging a large amount of water. Partition traps function like "P" traps but are not found as frequently because of higher cost. Drum traps usually are found on bathtubs, showers, and other fixtures discharging large amounts of water (not allowed in new homes). "S" traps which should not (and cannot legally) be used because they cannot be ventilated adequately and may siphon off water, thereby allowing sewer gas to enter. Mechanical traps which should not (and cannot legally) be used because they frequently malfunction. Remember, all fixtures must have a trap installed on the drain line. Toilets, by their basic design, contain a trap in the water-filled basin.
- "vents" allow sewer gas to escape through the home's roof and more importantly prevent the water in drain traps from being siphoned or blown out. For proper operation and safety, the following items should be considered when evaluating venting in a home's drainage system:
  - every fixture must be vented.
  - on the top floor, the soil stack extending through the roof may be used to vent a toilet (water closet) connected to the stack for drainage if the toilet is within 4 feet of the stack.
  - in no case may a soil stack be used to ventilate any fixture if other fixtures enter the stack at a higher level.
  - when two or more fixtures drain into the same soil stack, each fixture must be vented into a branch vent that must either continue uninterrupted through the roof or join the soil stack at least 3 feet above the drain line connection of the highest fixture.
  - branch vents must be at least 6 inches above the highest overflow point of the fixtures being drained.
  - vent pipes must be sized according to the plumbing

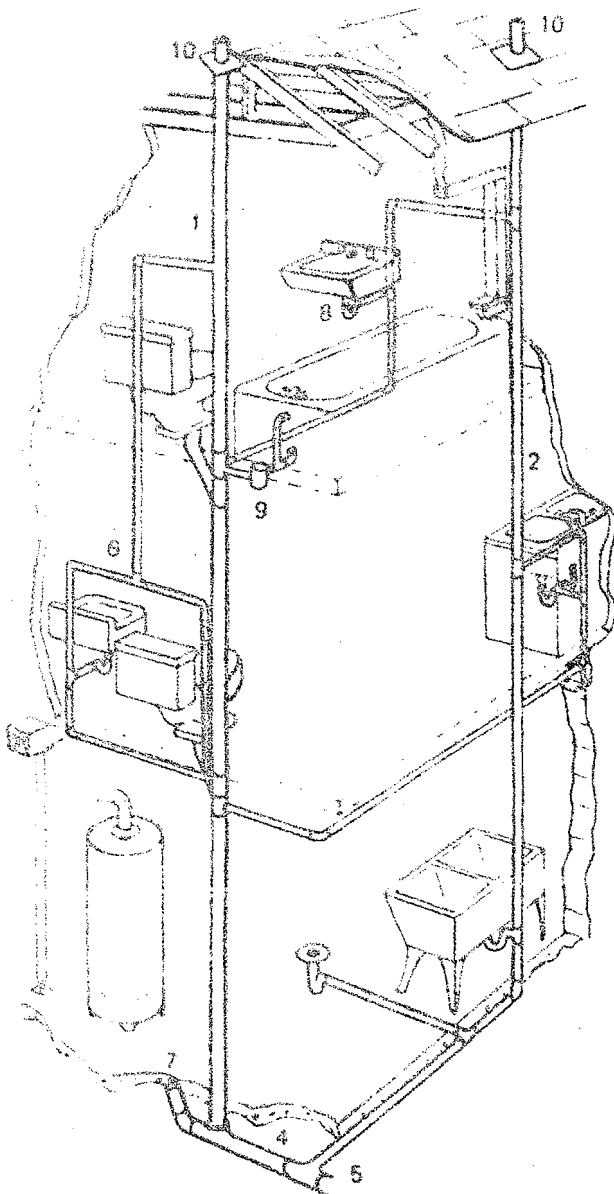


Diagram 5. Drainage System

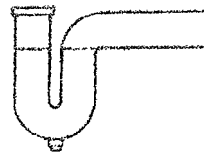
- |                            |                              |
|----------------------------|------------------------------|
| 1 = Main (soil) stack      | 6 = Branch vent              |
| 2 = Secondary (vent) stack | 7 = Clean out                |
| 3 = Branch drain           | 8 = P trap                   |
| 4 = Building drain         | 9 = Drum trap                |
| 5 = Building sewer         | 10 = Frost proof roof jacket |



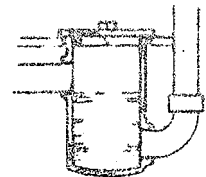
ing code (generally half as large as the drain lines vented and never less than 1½ inches).

types of drainage pipes commonly found in older homes include:

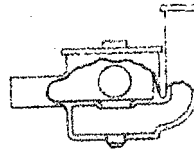
- cast iron in 2- and 4-inch sizes; used for most underground and many aboveground installations; least expensive, but most difficult for do-it-yourselfers if oakum and lead joints are used. Cast iron pipe fittings and gaskets may be used to simplify working with cast iron.
- galvanized steel in ½- to 4-inch sizes; used for aboveground installation only; easier for handyman than oakum-lead joined cast iron pipe, although galvanized steel pipe must be threaded.
- copper is seldom used because of cost; if used, it should be used only in aboveground installations; connections are made by sweating (soldering) or, in the case of "flexible" copper tubing, with flared fittings.
- plastic is becoming more popular in replumbing because of its moderate cost and ease of handling; ABS or PVC "Schedule 40" or, better yet, thicker "Schedule 80" plastic may be used for building sewers, building drains, branch drains, waste stacks, soil stacks, and vents.



**"P" TRAPS.**  
Most common. Found on fixtures not discharging much water.



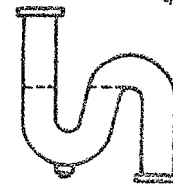
**"DRUM" TRAPS.**  
Found on fixtures discharging large amounts of water. Not allowed in new homes.



**"MECHANICAL" TRAPS.**  
Illegal. Frequently malfunction.



**"PARTITION" TRAPS.**  
Function like "P" traps. Costly so not found frequently.



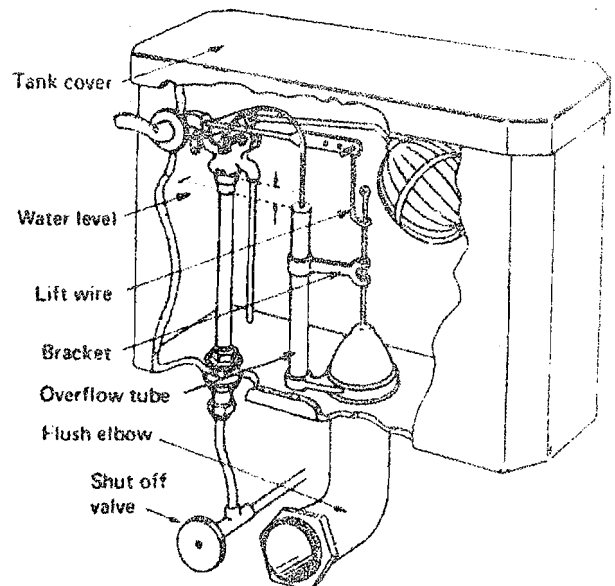
**"S" TRAPS.**  
Illegal. Cannot be adequately ventilated. May siphon off water allowing sewer gas to enter.

## FIXTURES

Plumbing fixtures in older homes seldom wear out. They are generally replaced because of dated appearance or abuse. However, things to consider when evaluating an older home or considering remodeling are:

- material—plumbing fixtures generally are made from the following materials:
  - vitreous china—a fired clay with glazed surface, very durable, always used for toilets and frequently for lavatories (bathroom sinks).
  - enameled cast iron—porcelain enamel fused to cast iron shaped fixture, susceptible to chipping, acid-resistant should be used for kitchen sinks.
  - enameled steel—porcelain enamel fused to pressed steel shaped fixture, susceptible to chipping, mostly acid resistant finishes.
  - stainless steel—very durable and will not chip, popular for kitchen sinks.
  - fiberglass—lightweight and usually does not need additional framing (bathtubs, shower compartments, etc.), susceptible to scratching.
  - chrome on brass—most durable finish for faucets.
- toilets—the three basic types of toilets or water closets are:
  - siphon-jet—most expensive, most desirable be-

Figure 7. Approved Ballcock Installation



1. All flush tanks shall be equipped with an approved anti siphon ball cock.
2. The ball cock shall deliver water through either an air gap or vacuum breaker.
3. The ball cock should be marked with a critical level, "C.L."
4. The critical level of the ball cock shall be 1 inch above the top of the overflow.
5. Without a "C.L." marking, the bottom of the vacuum breaker shall be taken as the "C.L."
6. The overflow tube shall not be cut off, because this would result in an incomplete flush.

cause it is quiet and efficient with the largest water surface.

- reverse-trap—most commonly used today, not as quiet nor as effective in flushing as the siphon-jet.
- wash-down—least expensive, least desirable in quietness and flushing effectiveness.

Toilets are potential serious sources of contamination. Diagram 7 shows the proper and approved ballcock installation.

## SUMMARY

In addition to the fixtures, a plumbing system is composed of two main parts, the fresh water and drainage systems. The fresh water system operates under pressure and is entirely enclosed. The drainage system operates by gravity (with all drainage lines sloping toward the sewer) and is open, with vents to exhaust dangerous sewer gases and equalize pressure and traps to block sewer gas from entering through fixtures.

## REPLUMBING AND PLUMBING PROCEDURES AND REQUIREMENTS

The following steps will help insure that a plumbing job is safe, adequate, and legal. Follow these steps to avoid exposing your family to hazards and you also will avoid being cheated by incompetent operators.

### First, Can You Legally Do Your Own Plumbing Work?

The answer is yes for remodelers or members of their immediate families (parent, child, spouse, parent-in-law) who own and occupy the single-family home where the work is to be done. Some local inspection departments (including Minneapolis and St. Paul) require the remodeler to sign an affidavit (before a permit is issued for do-it-yourself work) stating that 1) he, she, or a member of the immediate family lives at and owns the single-family dwelling for which the permit is requested and 2) he, she, or a member of the immediate family will personally perform all labor in connection with the permit.

If the remodeler does not wish to do his or her own plumbing, or he or she lives in a community with a population of 5,000 or more<sup>3</sup>, or if the home is connected to a municipal water system, the Minnesota Plumbing Code requires that a licensed and bonded plumbing contractor be hired.

### So You Legally Can Do The Work, Should You?

The answer is maybe. If a remodeler knows what he or she is doing, knows the code requirements, has the time and patience, has the tools, and understands the health hazards of improperly installed plumbing, the answer is probably yes. Otherwise, a licensed and bonded plumbing contractor is the best way to go.

### Remember, A Permit Is Desirable and Usually Required Before Work Begins!

If the remodeler lives in a community of 5,000 or more population or if the home is connected to municipal water system, a permit must be obtained before anyone begins plumbing work. Even competent do-it-yourselfers and licensed and bonded plumbing contractors occasionally make mistakes. With a permit, the consumer is assured that the inspector will do everything he or she can to help and protect the consumer. When the job is completed, the inspector will make a final check to make sure that everything is safe for the family and neighbors.

### What If You Decide to Hire a Plumbing Contractor?

The most important consideration becomes how to select a competent, licensed and bonded contractor.

First, check with the local plumbing inspector, or contact the Minnesota Department of Health (717 Delaware Avenue S.E., Minneapolis 55414) to insure the contractor is licensed. Ask material suppliers, neighbors, and friends for their recommendations. Check with your Better Business Bureau about the contractor's record.

Shop around; charges for the same work may vary as much as 100 percent. Request written bids from several contractors. When comparing bids, make sure the contractors were bidding on the same amount of work. Also realize that a low bid may be undesirable if the resulting job is full of problems and delays. Consider the contractor's track record as well as his or her bid.

It is desirable to have a written contract specifying 1) the total and itemized costs, 2) that the contractor will obtain all necessary plumbing permits in his or her own name, 3) that the home's plumbing will meet or exceed all applicable codes when completed, and 4) that final payment will be made after the plumbing inspector's final inspection and after the contractor has furnished lien waivers from all material suppliers and subcontractors (as required by Minnesota law).

<sup>3</sup>Or a community of any size if the community has adopted the state building code.