

Fixtures and the parts inside them

YES Electric • a plain-language course for new plumbing apprentices

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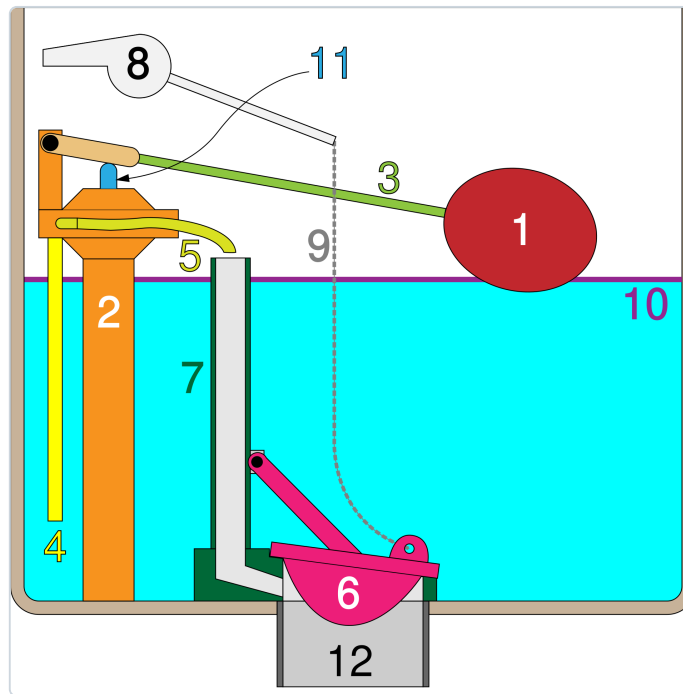
A fixture is anything a person uses water at. A toilet, a sink, a tub, a shower, a washing machine hookup, a water heater. Every fixture is where the supply road and the drain road meet. Every fixture has its own small set of parts that wear out, and those parts make up most of a service plumber's day. This module takes each fixture apart in words so the apprentice knows what is inside before touching one.

Toilet

A toilet has two main pieces, the tank on top and the bowl underneath, bolted together with a rubber gasket between them. Water sits in the tank. When the handle is pushed, the tank dumps into the bowl, the rush of water pushes the bowl's contents over the built-in trap, and the tank refills. The whole thing is porcelain and cracks if a bolt is overtightened.

Inside the tank

Part	What it does
Fill valve	A tall plastic tower on the left side. It opens when the tank is empty and shuts when the float rises to the set level. Replaces the old brass ballcock with the big floating ball.
Float	A cup that slides on the fill valve, or a ball on an arm on older valves. It tells the fill valve when the tank is full.
Flush valve	The big opening in the bottom center of the tank where water leaves.
Flapper	The rubber cap that seals the flush valve. The chain from the handle lifts it. When the tank is nearly empty, it drops back and seals.
Overflow tube	A vertical tube on the flush valve. If the fill valve fails to shut off, water runs down this tube into the bowl instead of over the rim onto the floor.
Refill tube	A small rubber tube from the fill valve that drips into the overflow tube while the tank fills. It refills the bowl so the trap seal is restored.
Handle and lift chain	The lever and the chain to the flapper.
Tank-to-bowl gasket and bolts	The seal between the two pieces.



Inside a toilet tank: 1 float, 2 fill valve, 3 lift arm, 4 tank fill tube, 5 bowl refill tube, 6 flush valve flapper, 7 overflow tube, 8 flush handle, 9 chain, 10 water line, 11 fill valve shaft, 12 flush tube to the bowl. Pushing the handle lifts the flapper by the chain; the falling water level drops the float and opens the fill valve.

Photo: File:Gravity toilet valves at rest.svg by Klork, CC BY-SA 3.0.

The water level in the tank should sit about an inch below the top of the overflow tube. If it is higher, the fill valve is set wrong or has failed and water runs constantly down the overflow. If the flapper is worn, water seeps past it into the bowl and the fill valve kicks on every few minutes to make it up. Those two failures are the running toilet, the most common service call there is.

Under the bowl

The bowl sits on a closet flange, the ring glued to the top of the drain pipe and screwed to the floor. Two closet bolts stand up from slots in the flange. Between the bowl and the flange is a wax ring, a thick donut of wax that squishes to make the seal when the toilet is set. Waxless seals made of rubber do the same job and can be reset if the toilet has to come up again. The bowl drops over the bolts, nuts snug it down, and caulk goes around the base. Most plumbers leave the back of the base uncaulked so a leak at the wax ring shows up on the floor instead of hiding under the toilet.



A closet flange set in a concrete floor with the toilet removed. The toilet sits on a wax ring on this flange and is held down by closet bolts in the slots. The note is from a fire-stopping test; the drain pipe runs down through the floor below the flange.

Photo: File:Toilet flange.jpg by Achim Hering, Public domain.

Behind the toilet on the wall, about 6 inches up and 6 inches left of center, is the 1/2 inch supply stub with a stop valve and a 3/8 inch braided supply tube up to the fill valve.

Rough-in numbers

The flange center sits 12 inches from the finished wall. There must be 15 inches from the flange center to anything on either side, and 21 inches clear in front. Module P05 has the full list.

Bathroom sink (lavatory)

A lavatory is a bathroom sink. The faucet, the drain, and the trap under it are the parts.

The faucet

A faucet mounts through holes in the sink or the counter. A single-hole faucet has one body. A centerset has the handles 4 inches apart on one base. A widespread has three separate pieces 8 inches apart. Under the sink, each faucet has two supply connections and a mounting nut that holds it to the deck. Inside the faucet body is the part that actually controls the water, and it is one of four types:

Type	How to know	Wear part
Compression	Two handles that turn several times	Rubber washer and seat
Cartridge	One or two handles, quarter turn or lift	Plastic or brass cartridge, brand-specific

Type	How to know	Wear part
Ball	One handle on a round cap, lifts and swings	Springs, rubber seats, and the ball
Ceramic disc	One handle, smooth short travel	Two ceramic discs in a cylinder

The drain

The hole in the sink bottom holds a pop-up assembly, the drain with a stopper that lifts and drops when you pull the rod behind the faucet. On the underside, a tailpiece drops from the pop-up to the trap. The P-trap connects to the tailpiece with a slip nut and washer and to the wall with a trap arm and a trap adapter. Where the trap arm enters the wall, a chrome or plastic ring called an escutcheon covers the hole.



Under a wall-hung lavatory: the chrome tailpiece drops from the sink drain into a P-trap, and the trap arm runs back through an escutcheon into the wall. Slip-joint nuts hold each piece; the trap holds a water seal that blocks sewer gas.

Photo: File:Trap5798.JPG by mariemon, CC BY 3.0.

Everything under a lavatory joins with slip joints, which are nuts and soft washers that can be taken apart by hand or with channel locks. This is on purpose, because the trap has to come off to clear a clog. New washers go on every time a trap is reassembled.

Supply

Two 1/2 inch stubs come out of the wall at about 20 to 22 inches off the floor, 8 inches apart. Each gets an angle stop and a 3/8 inch braided supply tube up to the faucet tails. Hot on the left, cold on the right.

Kitchen sink

A kitchen sink works like a lavatory with more hanging under it. The drain is a basket strainer, a wide flange set in plumber's putty with a removable basket, instead of a pop-up. A two-bowl sink has two strainers and a continuous waste that joins them to one trap. If there is a disposal, it mounts on one strainer flange and drains through its own elbow into the continuous waste.

Garbage disposal

A disposal hangs from a mounting ring on the sink flange. The ring has three screws and a snap ring. The disposal body twists onto the ring with a quarter turn. Inside is a spinning plate with swinging lugs that throw food against a grinding ring. Nothing in it is sharp. On the side is an inlet for the dishwasher drain hose, which comes plugged from the factory and must be knocked out before the dishwasher is connected. On the bottom is a red reset button and a hex socket for freeing a jam with the wrench that came with the unit.



Under a double kitchen sink: the garbage disposal hangs from the mounting ring on the right-hand sink flange, and its discharge elbow runs into the white PVC drain that also takes the left basin. The dishwasher drain hose would connect to the small inlet on the side of the disposal.

Photo: File:Under Sink Garbage Disposal and White Pipes (53370206837).jpg by Tony Webster, CC BY 2.0.

Dishwasher

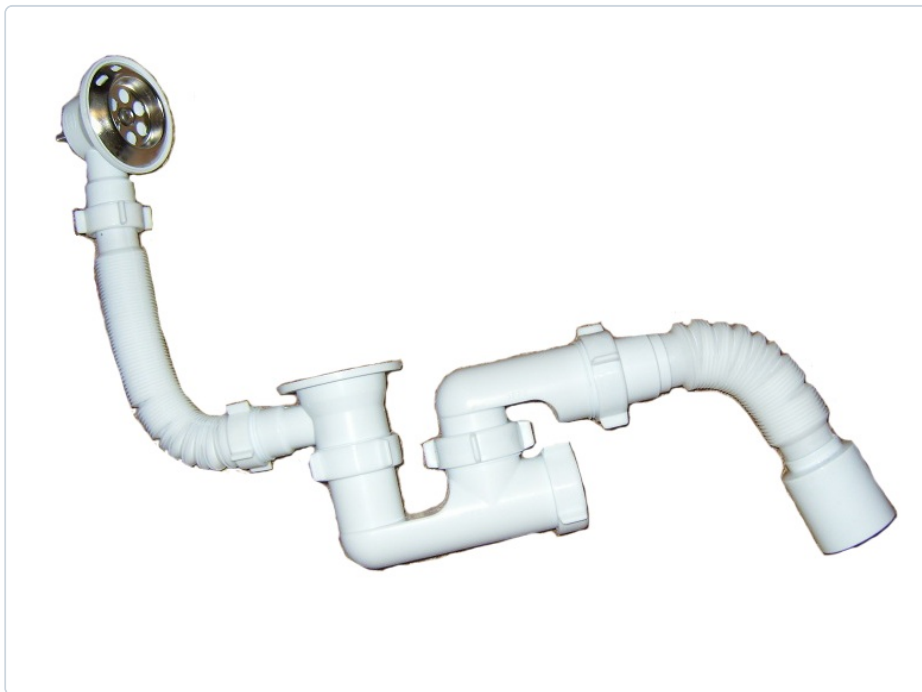
The dishwasher gets 1/2 inch hot water from a stop valve under the sink, usually a dual-outlet stop on the hot side, through a 3/8 inch line to a 90 degree fitting at the dishwasher inlet. Its drain hose runs to the disposal or to a branch tailpiece on the sink drain. The hose must either loop up to the underside of the counter, called a high loop, or go through an air gap, a little chrome cap on the sink deck. Either one stops dirty sink water from siphoning back into the dishwasher. The inspector looks for one or the other.

Ice maker

A 1/4 inch line runs from a stop valve, usually in a recessed box behind the refrigerator, to the ice maker. Saddle valves that pierce a pipe are no longer allowed in most places.

Bathtub

A tub has a drain at one end and an overflow hole partway up the end wall. Both connect under the tub to a waste and overflow assembly, a tee that joins the overflow pipe and the drain shoe and drops to a 1 1/2 inch trap below the floor. The stopper is a lever on the overflow plate, a pop-up, a lift-and-turn, or a toe-touch in the drain itself. The overflow plate has two screws and is where a snake goes in to clear a tub drain, because the drain shoe has a crossbar.



A bathtub waste-and-overflow assembly. The round overflow plate connects to the tub wall above the water line, the strainer sits in the tub bottom, and both run down to one trap below the tub that goes on to the drain.

Photo: File:Bathsifon.jpg by Луносвет, CC BY-SA 3.0.

On the wall, the mixing valve sits in the wall behind the trim. A tub spout screws or slips onto a short pipe at about 20 inches off the floor, 4 inches above the tub rim. A tub and shower combination has a diverter, either a knob on the spout or a third handle, that sends water up to the shower arm at about 78 inches. The shower arm is a bent chrome pipe that threads into a drop-ear elbow in the wall.

Access to the tub drain is from a panel in the wall behind the valve end, from below in a crawlspace or basement, or not at all, which is a problem the plumber plans for at rough-in.

Shower

A stand-alone shower has a drain in the floor with a 2 inch trap below it. The drain body clamps to the shower pan or the waterproof membrane under the tile. The pan itself slopes to the drain at about 1/4 inch per foot. The valve, head, and trim are the same parts as a tub and shower. Shower drains clog with hair at the strainer and in the trap, and shower pans fail where the drain meets the membrane.



A tiled shower floor opened up to show the drain fitting and the PVC trap sitting below the pan. The 2-inch trap keeps a water seal under the shower drain the same way a sink trap does; the pan then gets rebuilt over it.

Photo: File:Shower Repair.jpg by Hardyplants, CC BY-SA 3.0.

Washing machine

The hookup is a recessed box in the wall with hot and cold valves and a 2 inch standpipe for the drain hose. The standpipe is a vertical pipe that rises 18 to 42 inches above a 2 inch trap. The machine's drain hose hooks over the top of it. The hoses from the valves to the machine are rubber or braided stainless. Rubber ones burst with age and flood the house, so braided stainless is the standard replacement.

Water heater

A tank water heater is a steel tank with a glass lining inside, foam insulation around it, and a sheet metal jacket outside. Cold water goes in at the top through a dip tube that carries it to the bottom. Hot water leaves from the top. Heat comes from a gas burner under the tank or two electric elements screwed into the side.

Part	What it does
Dip tube	Plastic tube from the cold inlet to the bottom of the tank so cold water does not mix with the hot at the top. When it breaks, hot water runs out fast.
Anode rod	A magnesium or aluminum rod hanging from the top. It corrodes instead of the tank. When it is gone, the tank starts to rust.
Elements (electric)	Two screw-in heating elements, upper and lower, 4,500 watts each on a standard tank. Only one runs at a time.
Thermostats (electric)	One per element, behind the access panels, with a red reset button on the upper one.
Burner and gas valve (gas)	Burner under the tank, gas control valve on the front with the temperature dial.
Thermocouple or igniter (gas)	Proves the pilot or burner is lit. If it fails, the gas valve shuts.
Flue (gas)	The pipe up the middle of the tank and out the top that carries exhaust.
T&P valve	Temperature and pressure relief on the top or side. Opens at 150 psi or 210 degrees. 3/4 inch discharge pipe runs to within 6 inches of the floor.
Drain valve	Plastic or brass valve at the bottom for flushing sediment.
Expansion tank	On the cold line near the heater.
Dielectric unions or nipples	Keep the copper pipe from touching the steel tank fittings.
Pan	Catches a leak and drains it outside or to a floor drain.

Water heaters fail three ways. The elements or the thermocouple die and there is no hot water. The T&P valve or the drain valve drips. Or the tank itself rusts through and the heater gets replaced. Modules P06 covers all three.

Tankless

A tankless heater has no tank. A gas burner or a bank of electric elements heats water as it passes through a coil. It hangs on the wall, needs a bigger gas line and a bigger flue than a tank, and needs a yearly flush with vinegar to clear scale.

Hose bibs

A hose bib is a valve on the outside wall with a hose thread outlet. Frost-free sillcocks have the long stem described in Module P03. Every hose bib needs a vacuum breaker, a small brass cap that keeps hose water from being sucked back into the house supply. Frost-free units have it built in.

Check yourself

1. Name the two parts in a toilet tank that cause a running toilet and how you tell which one it is.
2. What does the refill tube do?
3. Why do plumbers leave the back of a toilet base uncaulked?
4. Name the four faucet types and the wear part in each.
5. Where does a snake go into a bathtub drain, and why not through the drain hole?
6. What two ways keep dirty sink water out of a dishwasher?
7. What does the anode rod in a water heater do?
8. What does the dip tube do, and what happens when it breaks?
9. Why must a hose bib have a vacuum breaker?

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