

Gas Safety exam revision and technical information.

Diverter Valve Working Principle

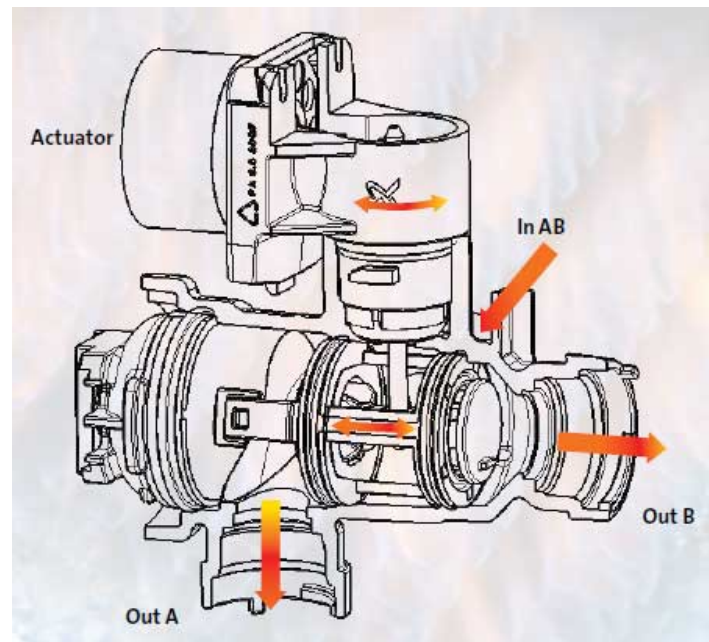
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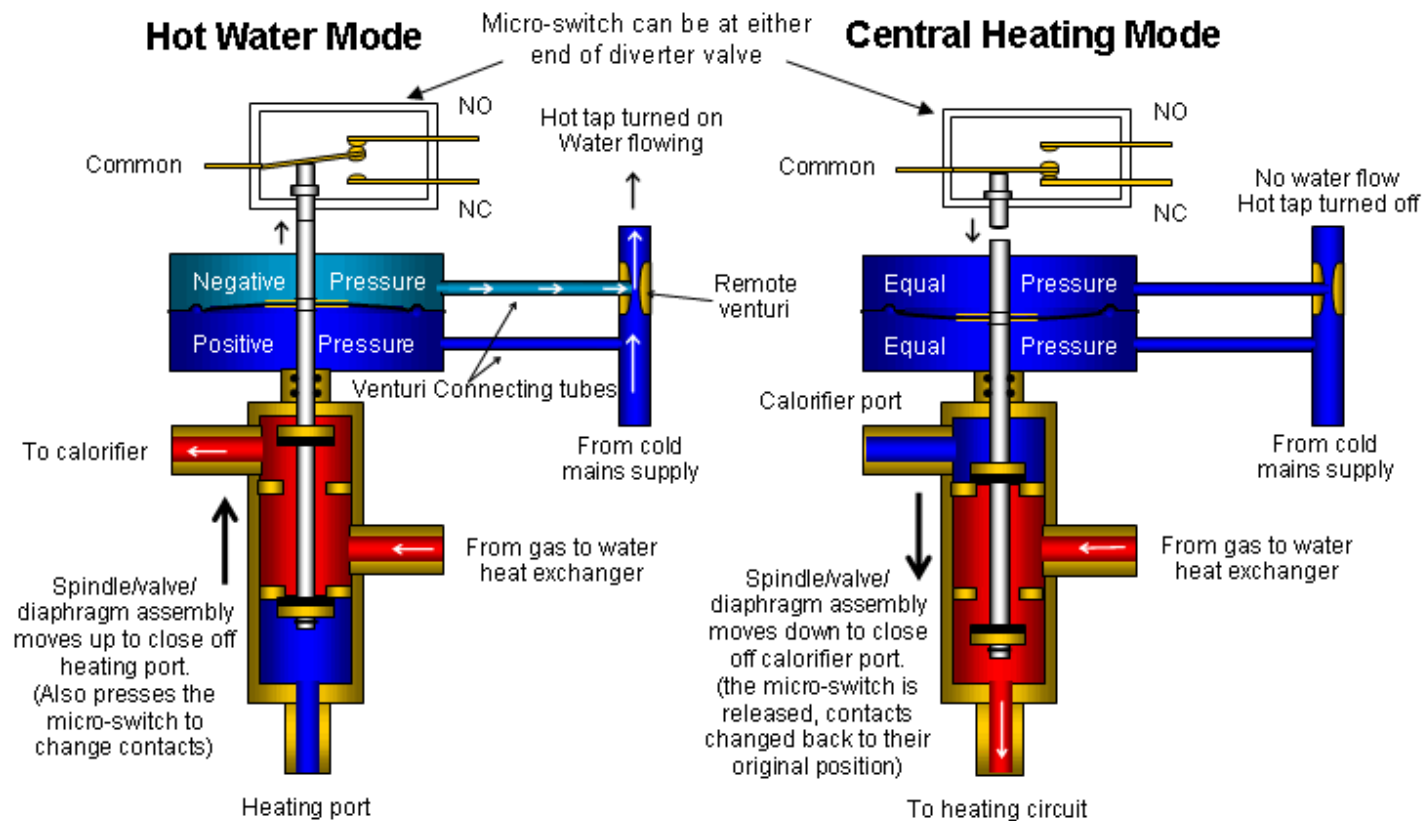
Diverter Valves in Gas Combi Boilers

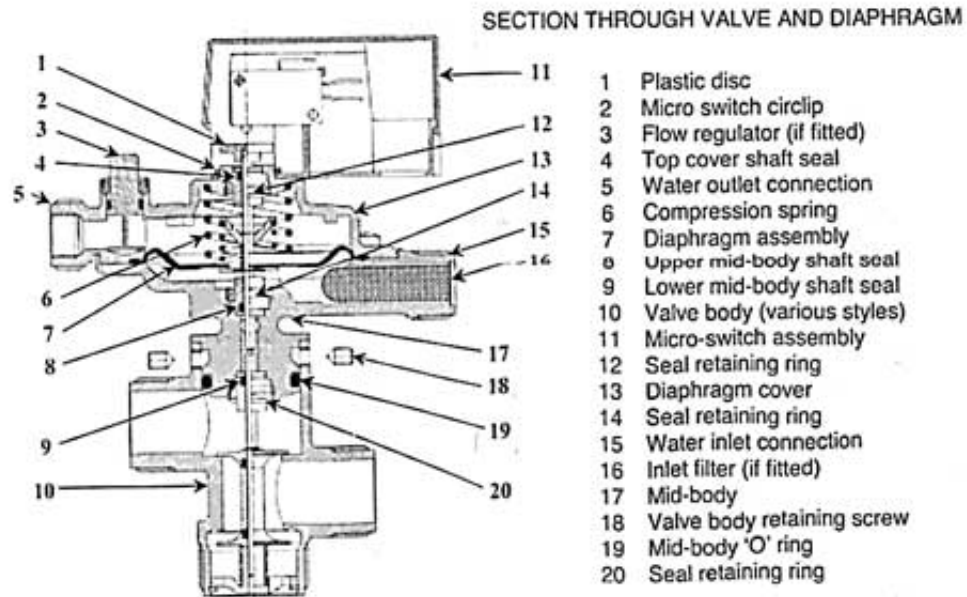
Most combi gas boilers have a complicated hydraulic circuit with a circulator pump and a diverter valve. There are two types of diverter valves. The first is a mechanically operated valve powered by a motored diverter head (just like a normal y plan system). Either switches to hot water or heating depends on what is being called for. The second one found on the SPA combis is a hydraulic three way valve. These have diaphragms in that are connected to push rods which operate microswitches to fire the boiler up. They work off a pressure differential valve in hot water mode and in heating mode its the pump.

Function:

- The valve piston moves inside the 3-way valve cartridge in the axial direction. The piston is operated by the lever arm (shaft), which is operated by the actuator.
- Due to the special principle of the valve, the shaft seal is not dynamically loaded by axial movement but statically loaded by a tilt motion. This prevents deposits at the shaft and extended wear.
- The actuator is usually a hydraulic diaphragm connected to the HW supply system. Opening a tap causes a drop in pressure on one side of the diaphragm, which is pushed by the pressure on the other side, operating 3-way valve. There are electric diverter valves (e.g., Honeywell) but they're far too slow for this application.







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Flue Gas Spillage Switches

A spill switch may be found at the draft hood on any modern gas fired appliance, such as a heating furnace (hot air heat), a heating boiler (hot water heat or steam heat), or a water heater. This little sensor, or two or more of them, form an important safety device that feels the heat of escaping combustion gases that ought to be going up the flue or chimney.

Since escaping combustion gases in a building are dangerous (forming a potentially fatal carbon monoxide hazard), if the sensor gets hot from flue gases flowing past its surface, it is designed to turn off the fuel supply to the gas burner.

Where are combustion gas spillage switches installed?

Combustion gas or flue gas spill switches are usually installed at the edge of the gas fired appliance draft hood. Some appliances may also have a spill switch installed at the gas burner opening itself.

This photo shows a spill switch at a gas fired water heater draft hood. In the somewhat blurry photo of dog hair blocking a heater draft hood (above) you can also make out the spill switch and its wire at the right edge of the draft hood in that photo.

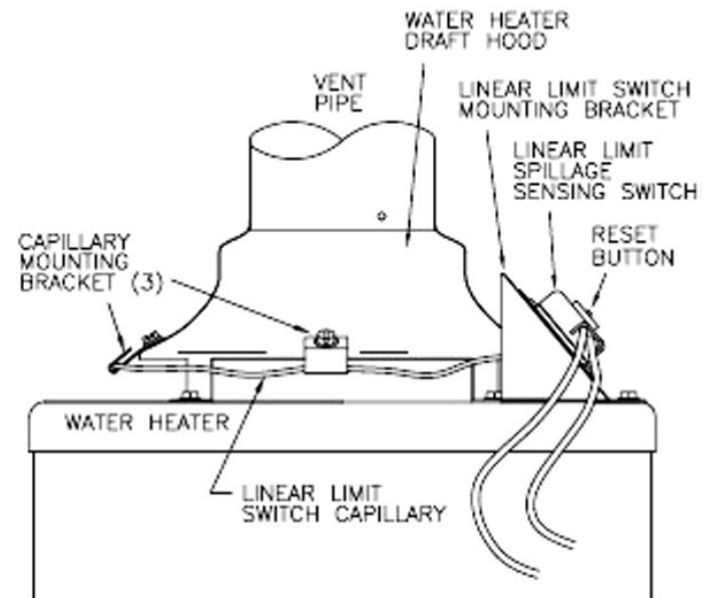
In the photo at left, a spill switch was not installed but had been simply left loose, disconnected, atop the water heater.

What goes wrong with flue gas spill switches

Missing flue gas spill switches: we've seen these switches removed from modern water heaters, gas boilers, or gas furnaces when they were originally installed. If you see holes drilled into the edge of a draft hood or other marks indicating that a device has been removed, or if you see the devices themselves lying loose, perhaps on or near the equipment, an expert service technician should examine the heater promptly as it may be unsafe.

Misplaced flue spillage switches: the spill switch needs to be installed in the proper location so that if a chimney blockage or some other operating problem causes combustion gases to spill out of the appliance into the building, the flow of flue gases, while still warm, will pass over the switch sensor. (There may be other flue spillage switches which sense carbon monoxide (CO) or other gases directly and without depending on the gas temperature.

Older heaters with no flue spill switch: On older heating systems these safety switches may not be installed at all. A spill switch or a set of them



can be added to almost any gas fired appliance, but it is likely that the gas control valve/regulator will need to be replaced too, since the old regulator may not have a point to which the spill switch's sensor wire can be connected to tell the valve to close.

Flue gas spill switch operating failure: While a spill switch could simply fail to sense passing hot gases and thus not perform its safety function of turning off the heater, or while such as switch might simply fail internally, forcing the heater to turn off when it should not, in our experience these are rare events. We do not have at hand industry failure rates for this device but we suspect that installation errors or omissions are far more common.

Some Spill Switches on Gas Equipment Include a Reset Switch or Button



Flue gas spill switches normally connect to the gas valve on gas fired appliances and the switch will shut the valve after sensing flue gas spillage such as that which could occur if the flue becomes blocked.

Many flue gas spill sensor switches, such as the Field Controls GSK-3, GSK-4, GSK-250M switches (which operate based on sensing temperatures of 180, 200, or 250 degF respectively) include a manual reset switch.

The manual reset switch is needed because a gas appliance pilot light can turn off for more reasons than a blocked flue or chimney problem that is resulting in dangerous flue gas spillage.

SAFETY WARNING: If your gas fired equipment has shut down in SAFETY OFF position it may be due to a resettable flue gas spill sensor switch. Check with your heating service company - you might think you can avoid a costly heating service call, BUT BEWARE: because flue gas spillage is very dangerous, including the production of potentially fatal carbon monoxide gas, don't simply reset the system without finding out what caused the

problem in the first place.

Here is a sketch of the Tjernlund Products Inc. Gas Spill Switch which also includes a manual reset button.

Tjernlund's sketch (left) shows the reset button right on the gas spill switch.

MORE SAFETY WARNINGS: in addition to our safety warning above, Tjernlund explains that flue gas safety switches are intended to alert the building occupants to a potentially dangerous condition.

But flue gas spillage safety switches are not a substitute for a regular chimney safety inspection nor do they replace regular heating appliance inspection and maintenance by a trained technician. Those steps must be taken as well.

Where are all the heating system reset buttons? If you are looking for the main reset button on heating equipment you'll want to see: AQUASTAT CONTROL Functions and CAD CELL RELAY SWITCH (hot water boilers and some water heaters), Stack Relay Switch on older oil fired boilers and furnaces, SPILL SWITCHES (gas fired equipment), and also Low Water Cutoff Controls on steam heating systems. At ELECTRIC MOTOR OVERLOAD RESET SWITCH we discuss the thermal overload switch and reset button that is found on many electric motors including those operating air conditioning fans, heating system oil burners, and furnace blowers and motors.

What causes unsafe flue gas spillage:

- Initial combustion of a gas fired appliance can cause brief flue gas spillage at the draft hood because the appliance may need time to warm up and start a good draft a cold chimney into which it vents. This is normal and the spillage should stop in less than three minutes as the flue and chimney are warmed. Flue gas spill sensor switches are designed to avoid false-tripping due to this condition.
- Improper chimney installation: such as venting a small BTUH appliance (a water heater) into a large masonry flue. Especially in cold weather the appliance may never develop adequate draft. We see this occurring when a building converts a heating boiler or furnace to a direct-vent system, no longer venting into the chimney, but where the water heater is left trying to vent into the old chimney flue.
- Inadequate combustion air supply to the heating appliance - located in a room too small with no outside air supply; located in a too-small utility room with a solid door that when closed, blocks air;
- Building depressurization - turning on fans in the building depressurizes the utility room or area around the heating appliance, overcoming the natural draft in the appliance's chimney. This condition might occur also with power-vented equipment in some conditions.
- Other reasons that a gas flame may be lost or a gas fired appliance shut off on safety may have nothing to do with bad flame or bad combustion air. For example a common part failure on gas fired heating equipment is the thermocouple that senses the pilot flame. If we can't keep a flame lit we suspect the thermocouple first.

