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## The boiler gas train

**Understanding this critical safety system can save your customers costly repairs.**

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One of the most misunderstood portions of the commercial heating system is the gas train. The gas train is a series of components that safely feed natural or propane gas into the burner.

The first component of the gas train is the sediment trap, more commonly referred to as the “dirt leg.” This is used to catch any dirt or moisture that may be entrained in the natural gas feed to the building. It is typically a nipple and cap located on the run of the tee. The gas feed is on a right angle coming from the bull of the tee.

The [American Society of Mechanical Engineers Controls and Safety Devices for Automatically Fired Boilers](#) (ASME CSD1) recommends a strainer before the other horizontal components in the gas train. Although not commonly installed, it is a good idea as it also will protect the gas train components from dirt.

Just past the strainer is the upstream manual gas valve. This manual gas valve usually has a 1/4 in. or 3/8 in. plug on the upstream side of the gas valve. The pipe plug is where the pipe or tubing should be attached to the burner pilot assembly. The pilot connection should be on the upstream side of the valve to allow the safety controls to be tested. The valve handle should be oriented so that it is parallel to the gas flow when open and perpendicular to the gas flow when closed. This allows you to quickly see whether the gas valve is open or closed.

The gas pressure regulator should be the next component. It will be upstream of all electric valves. The orientation of the regulator is important and is usually right side up, with the adjustment access on top. Inside the top of the regulator is an adjustment screw and a spring. On many regulators, the spring can be changed to allow different gas pressures to the burner.

The regulator usually has a fitting on top that is to be vented to the outside. This vent pipe can sometimes plug and fill with spiders or bees. If plugged, it will not allow the gas to flow, resulting in a no-heat call. A bug screen should be installed on the outdoor termination of the vent pipe. Some new regulators use vent limiters, which do not require venting to the outside.

The next item downstream in the gas train progression is the low-gas pressure switch. As you can guess, it will shut off power to the burner if the gas pressure is below the set point. The high-gas pressure switch will be located between the last manual gas valve and the burner. Many are located atop the burner housing. This will shut off power to the burner if the gas pressure is too high.

These controls usually have a manual reset that will require resetting if they trip. Many gas pressure switches should be vented outside. Gas pressure switches are not installed on every boiler and are typically used when the gas rating of the burner is greater than 2.5 million Btuh.

Safety shutoffs or valves are the next components in the gas train. Most likely it is two redundant electric valves that are to limit the chance of gas leaking into the boiler. If the state or municipality adheres to ASME CSD1, there will be a tapping with a valve and cap immediately after each valve. This is to allow the leak-testing of the gas valves.

Many valve manufacturers recommend leak-testing gas valves using a bubble test. The orientation may be important when installing the gas valves and the installation manual should be consulted to see whether the valves can be installed horizontally or vertically.

Some older gas trains used what was called a Block, Block and Bleed gas train. In between the two normally closed safety shutoff valves was a tee. The pipe from the bull of the tee was attached to a solenoid valve that was normally open. It was installed to vent any gas that may leak past the first electric safety shutoff valve to the outside.

If the system had this type of gas train, the outlet pipe from the solenoid valve was to be vented by itself to the outside. The other gas train components could be combined into a single vent but separate of the bleed valve piping. The solenoid valve should be checked on a regular basis to assure that gas is not leaking through it.

Another manual gas valve or the downstream manual gas valve is installed right past the last electric valve and before the modulating or firing rate valve.

The last component is the firing rate valve. This valve is operated by a modulating motor and will change according to input from the modulating control. It also may be called a butterfly valve. These are not installed on an on/off burner.

Be careful when using Teflon tape or pipe dope on the gas train threads as many manufacturers will not allow it and could actually void the warranty.

## Client stories

“Be careful as the flames roll out the side of the boiler when it starts,” our new client warned us when we were going to perform a preseason check of the boiler. We saw what he was warning us about immediately as the boiler started. Flames did indeed roll out of the boiler and licked the boiler jacket.

The cause of this anomaly was the improper installation of the gas pressure regulator, which was downstream of the first electric gas valve. When the electric gas valve was powered off, the gas pressure regulator would open wide. After the gas valve was energized and open, the regulator would be wide open and overfeed the gas to the burner. The gas pressure would regulate itself to the proper setting but not until the flame shot out of the side of the boiler.

To repair the problem, the regulator had to be relocated upstream of the electric valves.

In some areas, a relief valve is required. I have never seen one on any of the projects my company has worked on, but ASME CSD1 recommends the installation.

“Our gas costs are suddenly very high,” another customer said. “What is wrong with your boiler?” I asked him if anything had changed since the boiler was installed and was assured that nothing had changed. He told me something was wrong with the boiler I installed more than 10 years ago.

When we arrived at the building, we saw that something had indeed changed. Someone had replaced the normally open bleed valve with a normally closed solenoid valve. No one knew who changed the valve. It must have been the Boiler Fairy who anonymously changes components and control settings. The solenoid valve would open when the safety shutoff valves opened, allowing a 1 1/4-in. pipe filled with gas to vent to the outside anytime the boiler was firing.

Once the valve was changed back, the client liked my boiler again.

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