

## Hot Water Boilers

Low water protection isn't just for steam boilers. Hot water boilers face the same perils of overheating damage if the water line drops too low. Many people don't think of this as often as they should because hot water boilers serve "closed" systems. They have pressure reducing valves that are supposed to feed water automatically should a leak develop.

The truth, however, is that a pressure reducing valve is no substitute for a low water cut-off. Pressure reducing, or "feed" valves, often clog with sediment and wind up not feeding at all. A buried pipe can corrode and spring a leak that flows faster than a "feed" valve can satisfy. Relief valves can pop and, while dumping water at a great rate, actually prevent the feed valve from operating.

Let's take a closer look at how we can protect these boilers.

### Hot Water Systems (Fig. Z)

As we said, the things that affect steam boilers also affect hot water boilers. If you run them with too much water the relief valve will open. If you run them with too little water they'll overheat and suffer damage.

A low water cut-off is the only sure way of protecting a hot water boiler from sudden loss of water. The ASME boiler code recognizes this by requiring all hot water boilers of 400,000 BTU/HR or more input to have low water fuel cut-off devices.

ASME doesn't call for low water cut-offs on smaller, residential boilers, but we think *all* hot water boilers, regardless of their size, must have protection. However, the International Mechanical Code requires low water cut-offs on **ALL** hot water and steam boilers. ITT McDonnell & Miller make several devices, both float and probe type, that protect and meet the needs of any boiler whether it's cast iron, steel, or copper construction (Fig. AA, BB, CC).

Hot water systems regularly lose water through faulty air vents, loose valve stem packing, cracked boiler sections, loose nipples, corroded pipes, broken or loose pump seals, leaking gaskets, dripping relief valves, to name just a few places. Most installers depend on their pressure reducing or feed valve, to replace the lost water automatically. But feed valves often clog with sediment, especially in hard water areas. And it's very easy to close the supply valve to a feed valve and forget to open it again.

On systems with buried pipes (say, a radiant heating system) a feed valve will open if a pipe breaks. It will feed fresh water continuously until it either clogs (and stops feeding) or destroys the ferrous components of the system with oxygen corrosion. A simple feed valve can wind up costing a lot more than its purchase price. This is why major suppliers of feed valves, such as ITT Bell & Gossett, recommend you close the feed valve once you've established your initial fill pressure.

This is also why we strongly recommend you use a low water cut-off on every hot water boiler. Feed valves are not a substitute for low water cut-offs. They can't protect your boilers from a low water condition. Feed valves are fine for filling the system initially, and for helping you vent air from the radiators. But once the system is up and running, you shouldn't look to them for protection.

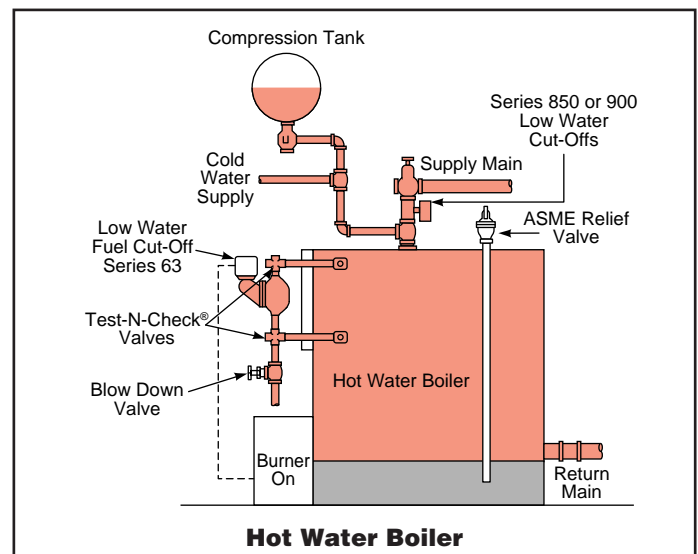


Fig. Z

## Over firing

There are times when hot water boilers don't lock-out on safety. Whether by control failure or human error, things go wrong. And when they go wrong in a hot water heating system, the water temperature can rise quickly to a point where the compression tank can't take up the expansion of the water. This causes the relief valve to discharge.

When the relief valve opens, there's a sudden drop in system pressure. The water, which at this point is probably much hotter than 212°F (100°C), will flash into steam. This is why ASME insists that relief valves for hot water boilers carry steam-discharge ratings.

If a feed valve doesn't open to replace this rapidly exiting water, a low water condition will quickly result. The only thing that can protect the boiler at this point is a low water cut-off. The feed valve can't protect the boiler because its typical setting is 12 psig (.83 bar). In other words, the system pressure must drop below 12 psig (.83 bar) before the feed valve will open.

The trouble is that while the relief valve is open and flashing steam to atmosphere, the internal system pressure never drops anywhere near 12 psig (.83 bar). A relief valve with a 30 psig (2.1 bar) setting, for instance, will open at 30 psig (2.1 bar), and close again when the pressure drops to about 26 psig (1.79 bar). The result is a loss of water with no make-up. Repeat this cycle enough times and the boiler will be in a dangerous, low water condition. Keep in mind, steam exerts pressure. It can easily fool a feed valve, and that's why feed valves offer very little protection at all against low water.



**Series 67 Float Type Low Water Cut-Off**

Fig. AA



**Series PS-851 Probe Type Low Water Cut-Off**

Fig. BB



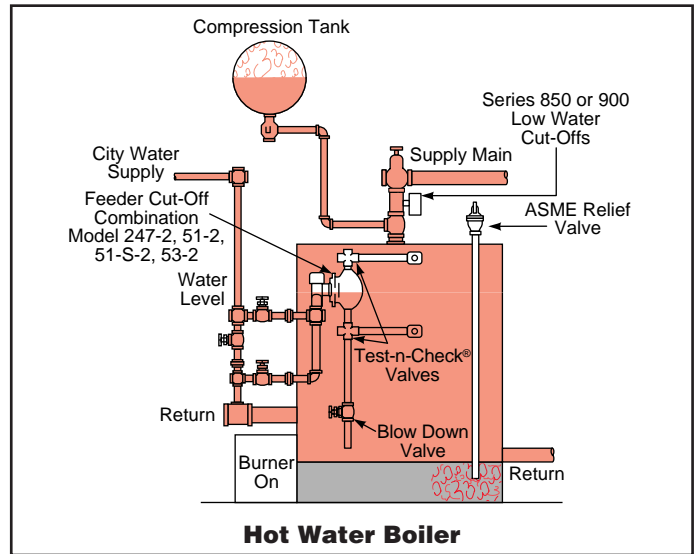
**Series RB-24 Probe Type Low Water Cut-Off**

Fig. CC

## Feeder/Cut-Off Combinations for Cast Iron and Steel Hot Water Boilers (Fig. DD)

To protect a boiler from dry firing, the low water cut-off must be located above the boiler's crown. After the low water cut-off shuts off the burner, you should have a way to add water to the system to ensure the crown stays under water.

A combination water feeder and low water cut-off can do this for you. If you position the feeder above the boiler's crown, it will mechanically feed water if the level should drop to that point. This is an important consideration because, even if the electricity is cut off, it's possible for the firing cycle to continue if the fuel feed valve is mechanically locked open. The combination unit's cut-off switch will act as a back-up to the primary low water cut-off, providing the boiler with additional protection.

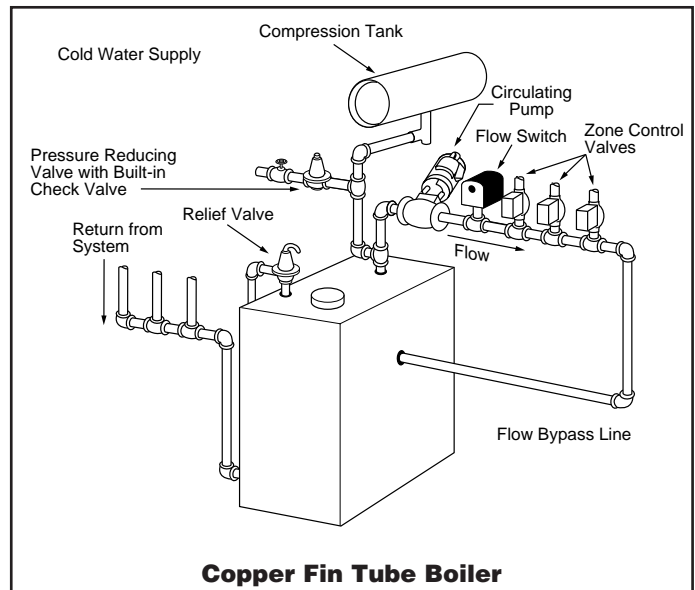


**Fig. DD**

## Protecting Copper Fin Tube Boilers (Fig. EE)

Copper fin tube boilers move heat from the flame to the water almost instantly. This type of boiler depends on the proper flow of water across its heat exchanger to move the heat quickly out of the boiler and into the system. Should flow stop while the burner is operating, heat will quickly build and cause the water in the heat exchanger to flash into steam. This condition is similar to a dry firing in a cast iron or steel boiler.

A McDonnell & Miller flow switch, installed on the copper fin tube boiler's hot water outlet, protects it from this danger (Fig. FF). The burner cannot fire unless water is moving across the flow switch. When the flow stops, for whatever reason, the McDonnell & Miller flow switch immediately cuts electrical power to the burner and protects the boiler from overheating.



**Fig. EE**



**Fig. FF**

## Pressure Relief Valves

(Fig. GG, HH)

**G**ood engineering practice calls for every hot water boiler to have a pressure relief valve. This spring-loaded valve must be able to release the boiler's entire load at the boiler's maximum operating pressure.

Here are some things that can cause a relief valve to open in a hot water heating system:

- The automatic feed valve fails, allowing higher than normal pressure to enter the system.
- Someone leaves a hand bypass line open after filling the system.
- Someone hydrostatically tests the system at a pressure greater than the relief valve's setting.
- The air cushion in the diaphragm type compression tank doesn't match the system's static fill pressure. Keep in mind, most tanks come from the factory precharged at 12 psig (.83 bar). If the system needs more than 12 psig (.83 bar) pressure, you have to add more air to the tank, and you have to do this while you have the tank disconnected from the system.
- The compression tank may be too small for the system.
- The boiler's aquastat is in a well without heat transfer grease. When this happens, the boiler's temperature will quickly exceed the aquastat's setting, causing rapid rise in system pressure.
- The circulator may be on the return side of the system with the compression tank at its suction. If it is, the circulator's head pressure will appear inside the boiler as a net increase. It may be enough to open the relief valve.
- The burner limit may be jumped-out or stuck in a manual position.

The main thing to keep in mind when you're troubleshooting this one is that relief valves pop when any of these three things happen:

- The compression tank loses it's air cushion
- The system takes on more water.
- The system temperature increases.

Think methodically, and keep your eyes wide open!

**W**e hope this Basic System Operation Guide has given you insight into the systems on which you're now working or will face in the future. We welcome any questions or comments you may have about the Guide, or about our products.

Thanks for your support, and for your continuing business.

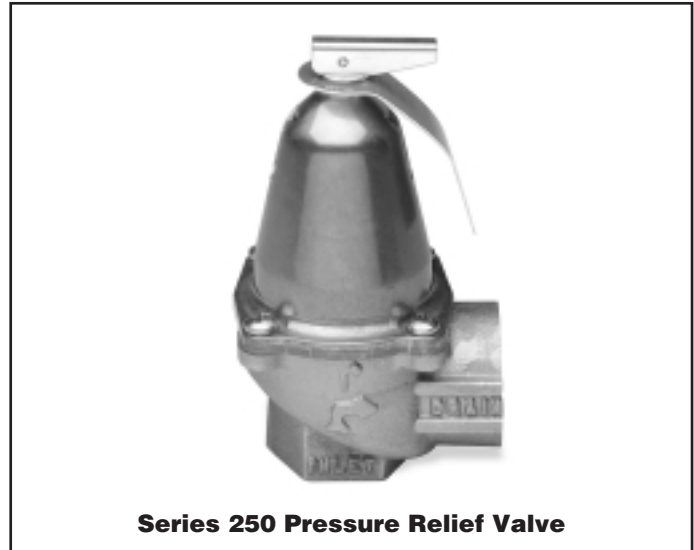


Fig. GG



Fig. HH

