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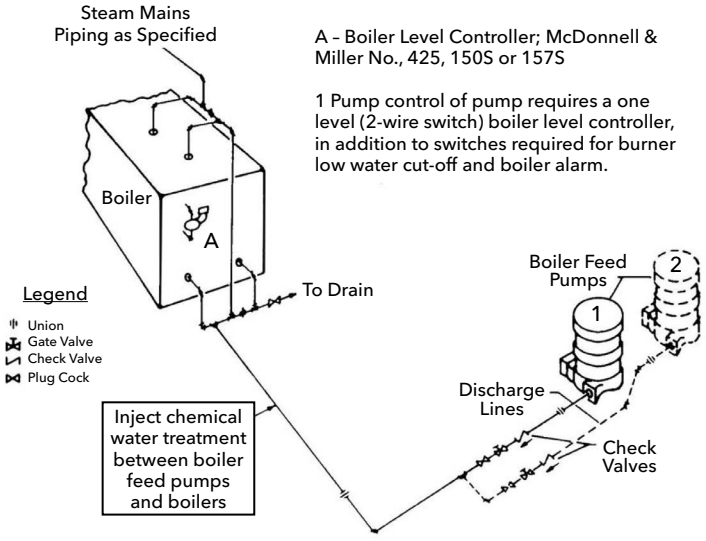
Typical boiler feed unit discharge piping arrangements

The following is a discussion of some of the more common discharge piping arrangements applied to boiler feed pumps. As previously discussed, use of a feed pump provides a reserve to feed the boiler, even when condensate is slow to return from the system. The economy of reusing treated water and feed water for its heat content is beneficial to the cost of operation, and reduces that amount of fresh water that needs to be added during heating cycles.

We will discuss five boiler feed piping arrangements that are adaptable to most low pressure boiler systems. Drawings are excerpted from the Section 190B document on our public website. 190B Bell & Gossett Domestic Boiler Feed Control

Drawing 1 DPD21-B below shows a single boiler with one pump for feed and a second pump for standby. Pump control for this arrangement is on the boiler, and is typically a single level of actuation for turning the pump on and off. Basic electrical control panels would typically include some type of starter or contactor with thermal overload protection to start the pump motors, and two auto-off-hand selector switches to determine which pump will be used as the feed pump.

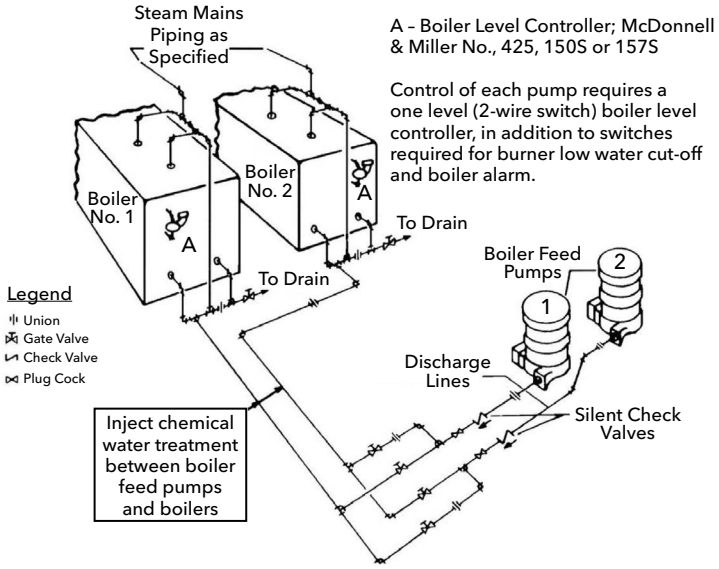


Drawing 1 DPD21-B - Elementary Piping Diagram

Domestic Pump CMED with B Pumps

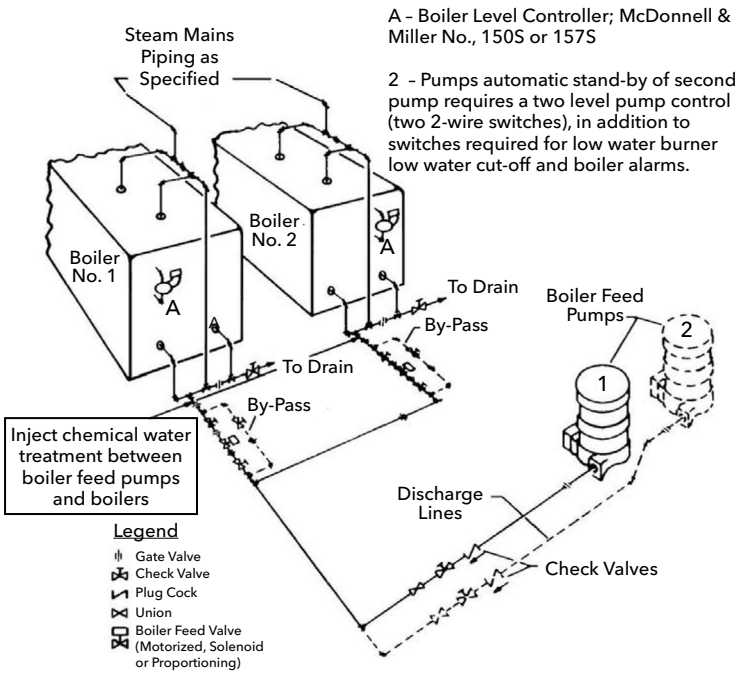
Another version of the same drawing (the C version) indicates that customers can set the unit for automatic standby if two levels of pump actuation that can be dedicated to pump control are provided on the pump controller. In an automatic standby situation, the level in the boiler would recede and the first set of pump control contacts would close to energize the first pump. If that pump either could not keep up with the demand for water or failed to energize as the level continued to fall, the second set of pump start-stop contacts would close and the standby pump would be turned on to assist in restoring the boiler water level. The piping is the same; only the control on the boiler and panel wiring change.

Drawing 1DPD17 shows the addition of a second boiler. Pumps and boilers are cross connected so that either pump can feed either boiler. Pump control for this arrangement is on the boiler, and is typically a single level of actuation for turning each boiler's pump on and off. Basic electrical control panels would typically include some type of starter or contactor with thermal overload protection for starting the pump motors, and two pump / boiler four-position selector switches. Selector switch number 1 would be for boiler number 1 and would be wired for off-hand-pump-1-pump-2. Selector switch number 2 would be for boiler number 2 and would be wired for off-hand-pump-2-pump-1. Thus, by opening and closing manual valves between the pumps and boilers and setting the selector switches appropriately, either pump can feed either boiler.



Drawing 1 DPD17 - Elementary Piping Diagram

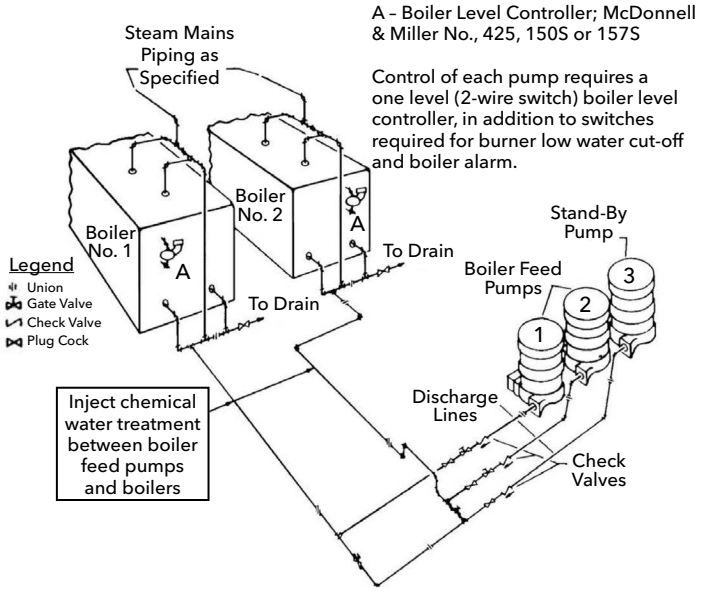
Drawing 1 DPD08-A shows two boilers with an automatic standby arrangement. In this arrangement, either pump can feed a boiler, with flow being directed to the respective boiler through some type of motorized, solenoid or proportioning valve. Pay special attention to the fact that, in this arrangement. each pump is sized for the total load of both boilers. Pump control for this arrangement is on the boiler, and is typically a two-level control. It typically controls the motorized valve, opening the valve to feed water into the appropriate boiler when the level in that boiler drops. An auxiliary switch associated with the motorized valve closes contacts to start a pump. If the level is restored in the boiler, the control will open, the motorized valve will close, and the auxiliary switch related to the valve will open and disengage the pump. If the level continues to fall in the boiler, the



Drawing 1 DPD08-A - Elementary Piping Diagram

second set of pump control contacts will energize, starting the second pump.

Drawing 1 DPD12 below shows two boilers. A third, dedicated standby pump has been added. In this instance, each pump is sized for the load of its respective boiler. If the two boilers are not identical in size, the standby pump is sized for the larger of the two boilers. Pump 3 is the dedicated standby pump, and can be connected to either boiler by opening and closing manual valves between the pump and the boilers. The typical pump control for this arrangement would be a single level of actuation on the boiler for pump control. Basic electrical control panels would typically include some type of starter or contactor with thermal overload protection to start the pump motors, and two pump / boiler four-position selector switches. Selector switch number 1 would be for boiler number 1 and would be wired for off-hand-pump-1-pump-3. Selector switch number 2 would be for boiler number 2 and would be wired for off-hand-pump-2-pump-3.



Drawing 1 DPD12 - Elementary Piping Diagram

An automatic standby version of this drawing is also available in the 190B document linked at the beginning of this discussion. Automatic standby would require two levels of pump actuation, and motorized valves of some type between pump 3 and both boilers in order to direct the flow to the boiler needing water.

It is important to note that automatic standby selections always require two levels of dedicated pump control, and in many cases auxiliary switches or relays to start the second pump automatically. As systems become more and more automated and more complex – adding additional boilers or changing alternation to an automatic style, for instance – additional ancillary items in the control panel are required that can complicate system operation and drive up costs dramatically.

When designing or replacing feed systems, and completing selections using the factory selection software, remember that feed units require the completion of the boiler feed questionnaire. A manual version is shown on page 2 of the

190B document. The factory needs to know the number of pump control signals to be used. This is different from how many are on the control.

For example, a manual system that has a M&M 150S controller for pump control has two levels on the control, but only one is needed for the pump. The second level in the case of the manual system can be used for some other appropriate function. This, however, does not negate ASME CSD1-1 safety codes that indicate there should always be two low water cutoffs on a steam boiler. In the case of the manual system, you might opt to use the second level of the M&M two-level control for the pump to actuate alarm or burner cutoff. But there must be a separate and independent low water cut-off as well. In automatic systems where both levels of actuation are used, there must be two additional low water cutoffs to protect the boiler. There is a strong case to be made in many of these instances to subscribe to the KIS method (i.e. Keep It Simple).

If you have any questions on feed pumping systems, contact your local Bell & Gossett representative.

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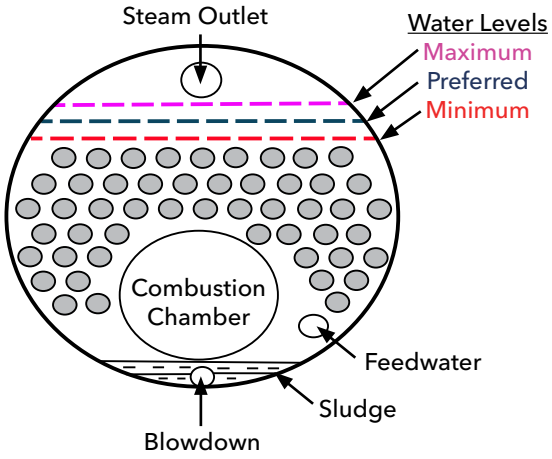
What is the normal water line in a steam boiler?

All boiler manufacturers identify the "normal water line" in their instruction manuals. It is typically denoted as "NWL," and describes the height in inches from the bottom of the boilerup to this line. By not paying attention to the NWL, you can set yourself up for a whole lot of headaches. Manufacturers today know that, for their boilers to provide good "dry" steam, they have to rely on the near-boiler piping to help shake out any water that has come out of the boiler with the steam.



Water level diagram

Most manufacturers list the height of the boiler's heading as at least 24", above the normal water line, because:

1) they want to minimize the amount of water that can climb up the supply riser(s) with the high velocity steam that is leaving the boiler, and

2) as the equalizer drip line fills with water on start-up because steam is condensing in the near-boiler piping, they don't want this water to back up into the header piping. If this happens, the header piping's internal diameter is drastically reduced, which immediately increases the steam's velocity, and that can cause more problems.

WFE UniMatch Water Feeder

Series PSE-800

The higher velocity steam will literally suck additional water right up out of the boiler and out to the system. This water-laden steam will condense prematurely because the water will rob the latent heat from the steam, causing uneven distribution of heat throughout the building. It will cause the steam vents to spit condensate. It will create water hammer because condensate will slam into elbows, tees and anything else in its way. It will also create a low water condition back in the boiler because so much water left the boiler prematurely. The only time the water level is the normal water line is when the boiler is off and cold. (Figure 1)

NORMAL WATER LEVEL is only normal when the boiler is off and cold.

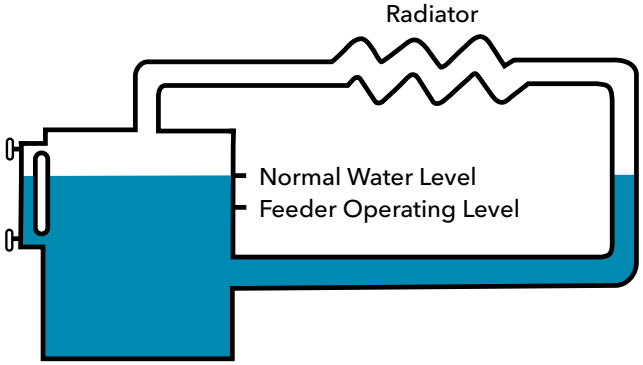


Figure 1

As soon as the boiler starts to make steam, the water line has to change because some of the water is changing state from a liquid to a gas. (Figure 2) How fast the water changes into steam is a function of the boiler's BTU /H capacity. An easy rule of thumb when attempting to calculate the boiler's steaming rate is 0.5 GPM for every 1,000 square feet of equivalent direct radiation (EDR). This means water is being taken out of the boiler in the form of steam, at a rate of 0.5 GPM for every 1,000 square foot rating of the boiler. If you have a residential steam boiler capable of providing 500 square feet of steam, water is leaving the boiler at a rate of 1/4 GPM for every minute the boiler is firing. If a boiler firing cycle lasts 15 minutes and the condensate hasn't started to return, 3.75 gallons of water will have left the boiler. That is a substantial amount of water that is no longer in the boiler.

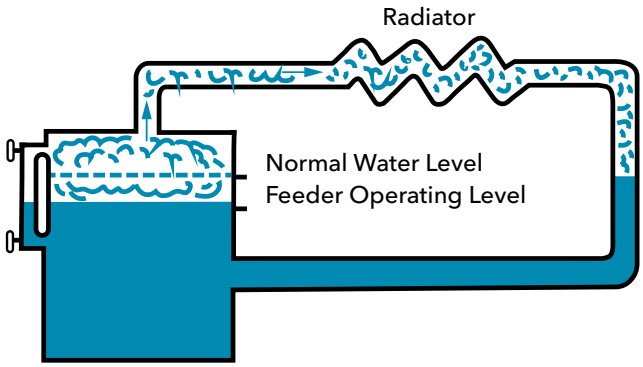


Figure 2

We know how the NWL is established, but how it is set in a boiler? The only way to set the proper water level is by manually filling the boiler to the proper level. Some believe that an automatic water feeder is responsible for maintaining this water line, but a feeder's only function is to maintain a safe minimum water level, working in conjunction with the low water cut-off. You don't want customers thinking that an automatic water feeder is a convenience item, lest they forget about the importance of regularly checking their boilers.

If you have any questions about low water cut-offs, automatic water feeders and steam boilers, contact your local McDonnell & Miller representative. They are well trained on steam subjects.

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