

# Why the NWL (Normal Water Line) in a steam boiler is so important...



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As the heating season approaches and all those thermostats start clicking in relays for the first time, any replacement equipment that had been installed during the summer will be quickly tested. I have had an unusual amount of calls and questions on residential steam systems with new replacement boilers. Banging pipes, spitting vents, uneven heating...to name a few complaints.

Inevitably, there was some confusion during the installation process that led to these problems. I would respond by asking the question, "What is the normal water line in a steam boiler?" That is a question that a lot of people don't spend enough time thinking about. All manufacturers detail the answer in their instruction manuals. It is typically denoted as "NWL" and the manufacturer describes the height in inches from the bottom of the boiler up to this mysterious line. By not paying attention to this "little" detail, you can set yourself up for a whole lot of headaches.

Manufacturers today know that for their boilers to provide good "dry" steam, they will have to rely on the new boilers' near-boiler-piping to "shake" out any water that has come up out of the boiler.

One interesting dimension they get very specific about is the height of the boiler's header piping above the NWL. Most manufacturers list this suggested dimension to be at least 24". The reason for this is twofold;

1. They want to minimize the amount of water that can climb up the supply riser(s) with the high velocity steam that is flying out of the boiler
2. As the equalizer drip line fills with water on start-up (because the steam is condensing in the near-boiler-piping), they don't want this water to back up into the header piping.

If this is allowed to happen, the header piping's internal diameter is drastically reduced which immediately increases the steam's velocity, which can now cause more problems. 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 everywhere. It will create water hammer because the "balls" of condensate will be slammed into elbows, tees and anything else in its way. This high velocity steam will also create a low water

condition back in the boiler because of all the water that left the boiler prematurely.

So right out of the box, you can see how important this NWL dimension can be if you want to have a successful experience with replacing a steam boiler. Get to know this dimension and you'll be heading in the right direction.

The next part of this equation is, once you know what the Normal Water Line is, when is it normal? Think about that question, "when is the normal water line in a steam boiler normal?" The only time the water line is at the NWL or normal water line is when the boiler is off and cold. As soon as the steam boiler turns on and starts to make steam, the water line has to change, right? Of course it does, because some of the water is changing its state from a liquid to a gas (steam). How fast the water changes into steam is a function of the boiler's BTU/H (British thermal unit) capacity. An easy rule of thumb to refer to when attempting to

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calculate the boiler's steaming rate is one half gallon per minute (gpm) for every 1,000 square feet of EDR (equivalent direct radiation). This means water is being taking out of the boiler in the form of steam at a rate of ½ gpm for every 1,000 square foot rating of the boiler.

For example, if you had a residential steam boiler capable of providing 500 square feet of steam, water would be leaving the boiler at a rate of .25 (1/4) gpm for every minute the boiler is firing. If a boiler firing cycle lasted 15 minutes and the condensate hadn't started to return, 3.75 gallons of water would have left the boiler. That is a pretty substantial amount of water that is no longer in the boiler.

## How is the NWL set in a steam boiler?

We know how it is established—the manufacturers tell us in their installation manuals. However, how it is set has caused some confusion over the years. The only way to set the proper NWL is by manually filling the boiler to the proper level. There are some in the industry who think an automatic water feeder is responsible for maintaining this water line. They couldn't be more wrong! The only function an automatic water feeder provides is to maintain a safe minimum water level working in conjunction with the low water cut-off.

Its original intention was to prevent a freeze-up from occurring if a steam system developed a leak in its return piping and condensate couldn't return back to the boiler. It would cycle on and off with a call from the low water cut-off to keep just enough water in the boiler to allow the burner to keep firing. An automatic water feeder is not a convenience item and you don't want your customers thinking it is or they'll probably never go downstairs to check on their boiler again!

Speaking of low water cut-offs, how do they relate to the boiler's normal water line? As the name implies, a low water cut-off's (LWCO) job is to prevent a low water condition from occurring that would damage the boiler and possibly create a dangerous situation. The location of this LWCO is important if you want the steam boiler to operate properly. Again, the manufacturers do a good job telling us where the ideal location to install the LWCO is on their own boilers. It is usually somewhere near the bottom of the gauge glass. Most boilers will mark this location by imprinting on their jacket the words minimum water line. There are two types of

low water cut-offs you can choose from: the more traditional float style that uses a cast-iron body with a float inside that moves up and down in response to the boiler's water level. The other option is called a probe style low water cut-off. This device is screwed into a specific tapping called out by the boiler manufacturers.

This device uses the conductivity of water to complete an electrical circuit. If the probe sees water, everything is OK.

If there is no water around the probe, the electrical circuit is broken and the burner is turned off until the water level rises up to cover the probe again.

The relationship between the NWL (which you set manually) and the location of the low water cut-off (which the boiler manufacturer determines) is very important. The distance between these two determines how much water the boiler has to use to manufacture

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# EEE Adds Citgo as Business Partner



The Eastern Energy Expo (EEE) is excited to announce that Citgo Petroleum Corporation will be an official "Business Partner" to next year's show held May 22-26, at Foxwoods Resort Casino, Mashantucket, CT.

The Eastern Energy Expo will host attendees and vendors who are responsible for providing energy and home comfort needs to millions of consumers in the Northeast, one of the most populated regions in the



United States. Three of the industry's most prominent and successful trade shows have joined together to bring all facets of the energy and home comfort industries together under one roof. The Atlantic Region Energy Expo (AREE), Oil & Energy Service Professionals (OESP) and the Pennsylvania Petroleum Association (PPA)

are bringing a regional, all-encompassing conference to one convenient location.

This four-day event is designed around learning about the latest techniques and newest products, building new

relationships, and growing professionally in a friendly, fun environment—all at one time, in one place.

EEE spokesman and Fuel Merchants of NJ Executive Vice President Eric DeGesero stated, "We welcome Citgo as our Business Partner to this inaugural event. Their commitment will assure that this event will capture attention and participation from motor fuel and C-store marketers as Citgo's commitment to the show includes a dedicated business program track for his segment of the petroleum marketing industry. In addition, Citgo will be a visible presence on the trade show floor."

In addition, the five companies shown below have committed to the Expo as 2016 Diamond Sponsors. ICM



## Boiler Facts... *continued from p.17*

### Why the NWL (Normal Water Line) in a steam boiler is so important...

steam before the low water cut-off turns the burner off or tells the automatic feeder to add some water. We all know that the newer, more efficient boilers hold considerably less water in this range than the older boilers that you are replacing. Add to this the fact that the new boiler is being attached to a very old steam system with old piping, old steam mains that aren't pitched quite the same as they were when they were new and old return lines that are partially plugged which create resistance to the water trying to drain back to the new boiler. With all these potential factors working against you, it is very important to make sure you establish the proper NWL manually and that the LWCO is located at the lowest, safest point in the boiler. If not, you are going to have an over-active LWCO that will short cycle the burner or activate the automatic water feeder, thus flooding your new boiler.

Tankless coils can prevent a problem sometimes because the NWL usually leaves a portion of the coil exposed. During the heating season, this isn't much of a problem because whatever portion is above the water line will be heated by the steam in the steam chamber. However, come summertime, there is a

good chance you'll get a call from your customer complaining about their domestic hot water. The best solution is to manually raise the water line to submerge the coil, but just for the summertime. Come the next heating season, the water line should be lowered to the recommended NWL.

Sometimes, the technician decides to raise the LWCO in an attempt to keep the coil constantly submerged by activating the water feeder more frequently. The problem with this solution is now the water line is much too close to exit hole(s). There is a very good chance the exiting steam will drag the water up out of the boiler, creating wet steam, water hammer and a premature low water condition in the boiler. You have to respect the dimensions established by the boiler manufacturers. You also have to understand the role of low water cut-offs and automatic water feeders.

If you have any questions or comments, e-mail me at [gcarey@fiainc.com](mailto:gcarey@fiainc.com), call me at 1-800-423-7187 or follow me on Twitter at @Ask\_Gcarey. I want to wish a Merry Christmas and a Healthy & Happy New Year to all of our ICM subscribers. May the heating season be healthy and prosperous for every one of you! ICM