BRANT STEEL PRODUCTS LTD. URGES ALL INSTALLERS OF DOMESTIC HEATING BOILERS TO PREVENT

Thermal shock.

By reading this article you will understand our concern. In a previous mailing, this message may have been unclear. Please contact Mr. Mark Offenhammer if you have any further questions.

Phone (519) 756-5700
Fax (519) 756-1742
E-mail : fabricate@brantsteel.com
Web www.brantsteel.com

by John A. McAuley, Jr.

It truly amazes me that the boiler industry still has thermal shock problems! I have written several articles on the subject through the years. The American Boiler Manufacturers Association has publicly warned of the dangers of thermal shock. Yet, year after year, I come in contact with it.

Why? My idea is that the boiler manufacturer produces a boiler which is competitive and acceptable to the market, and then they sell it to the contractor. After all they've been selling the same boiler for fifty years, why redesign it now?

The contractor has bid a specified job, which was designed by a Professional Engineer. The P.E. approves the equipment so the contractor is off the hook. The boiler the contractor has submitted is either the least expensive he could find or old Joe (the boiler salesman), is an old friend and he's been installing Joe's boiler for years.

The engineer most likely doesn't even really know what thermal shock is. He is designing a complete mechanical system. He has to size boilers, chillers, pumps, piping, ducts, and design a control system. They are expected to know everything, many think they do, however in reality no human is perfect and knows all. There is just too much to know in the mechanical business.

The person selling the boiler is a manufacturer's representative. He represents one boiler manufacturer and believes his boiler will perform wonders. To him, it is undoubtedly the best piece of equipment for every job. He is paid a commission and has a quota to fill, filling this quota becomes his main concern. Many times he is a salesman first and a technical person last.

Last, but not least, comes the customer! Everyone he is dealing with has an excellent reputation: The job looks beautiful to him when it is completed. Within a few years, however, the boiler starts to crack, usually in the spring or fall. Everyone has been paid and they are all off on other jobs by now. The customer is naturally irate, so in come the attorneys.

Who's fault is it? Everyone, except the customer!

I can understand something which is new and strange happening. Sometimes we have a problem with a system which is due to something weird, which no one has seen before.

That is not the case with thermal shock. If there is a contractor, manufacturer, sales representative, or engineer who says he has never come in contact with thermal shock, I would question his credentials.

We come in contact with at least six thermal shock problems a year in the Washington, D.C. area alone. We have never failed to remedy the cause of the thermal shock and leave the customer operating properly.

One particular problem I remember was a boiler which was piped in backwards for over twenty years! This customer had replaced tubes on a monthly basis for over twenty years! I cannot believe that all of the other people who had been in the boiler room during this twenty year period didn't investigate the problem. (Maybe they just didn't know what to look for. I hope that is the answer versus they didn't care.)

We are all individuals serving the customer in our various trades, or professions. However we have a group obligation to give that customer a quality job. I cannot believe that so many people can be lacking the pride in their profession which should be the top priority.

Thermal shock is a very simple problem. It occurs mostly on hot water steel boilers; however, steam boilers may be shocked also. The following are the visible signs of a possible thermal shock problem:

1. Cracked furnace tube, usually in the rear
2. Cracked tube sheet, again the rear one
3. Cracked tubes where they meet the rear tube sheet
4. Weeping water around the tubes where they are rolled into the rear tube sheet
5. Continuous mud leg stay bolt leaks

A boiler is no more than a big piece of steel. If it has proper water treatment, and is operated properly, it should last almost forever.

The boiler tubes should be good for twenty years.

Periodic leaking means something is wrong and should be investigated. It is usually not the boiler that has the problem; rather it is something external which causes the boiler to leak. The two major and most common causes of

thermal shock are: rapid entering of cold water into the boiler or overfiring a cold boiler.

The signs of thermal shock normally show up on the hottest part of the boiler. In the case of a scotch marine type, it will be at the rear where the hot gases make their turn from the furnace tube into the first row of tubes. In a water tube boiler, it will be on the lower half of the boiler on the combustion chamber tubes. In a brickset, firetube type it will normally be the staybolts in the mud legs, or the mud leg inside corners.

In a steam boiler thermal shock will normally occur in two ways-firing a cold boiler in high-fire or the condensate returning to the bottom rear of the boiler too cold. However, the incidences of thermal shock in steam boilers are not many.

In hot water boilers, the greatest cause, by far, is the three-way, system temperature control valve. In the spring and fall, our system may have water as low as 100 degrees in it. Boilers operate at 180 degrees, as an average. When system temperature starts to drop, the three-way mixing valve opens up to allow 180 degree boiler water into the loop to bring up the temperature. This 180 degree boiler water is replaced with 100 degree system water. It is like a glass being taken out of a hot dishwasher, and placing an ice cub in it-it cracks.

How do we prevent this from happening? There are two methods.

The first is to install a blend pump, sized large enough to bring the return water up from 100 degrees to no less than 40 degrees lower than the operating temperature. This pump must be sized for the worst case scenario and be piped between the boiler supply and return. The further away from the boiler inlet that you can tie in the line the better; this will give you more time to mix the water before it enters the boiler.

The second method would be to install a probe near the boiler inlet, in the path of the incoming water. This control would act as a limiter and protect the boiler from sudden rushes of cold water. When the temperature we are sensing drops more than 40 degrees below operating temperature, we would close the three-way valve from taking boiler water regardless of the loop temperature. This may cause a slight delay in bringing up the loop temperature but the boiler will not be damaged.

Honeywell manufactures a four-way valve, through its Central line which is designed with a probe in the boiler for exactly this purpose. This system is very successful if installed properly.

Why don't control manufacturers concern themselves with this problem? They design the temperature control system only-the boiler isn't their problem. Why don't the boiler manufacturers concern themselves with the problem? Their boiler will operate fine if there is a twenty degree system drop and the boiler is operated at 180 degrees.

The problem is that in today's market everyone is concerned with energy conservation and building temperature control. Every new building has a temperature control system which resets system temperature based on outside temperature and occupancy.

Why should a boiler be designed to operate as they did twenty years ago? Why shouldn't the control manufacturer be concerned with damage to the boiler, isn't it part of the system?

The problem of firing a cold boiler at maximum input is easily remedied. Install a low-fire hold control on every boiler, not as a customer option. This is no more than an aquastat that holds the boiler in low-fire until a certain water temperature is reached. Then it will allow our automatic controls to take over and the boiler will go to *high-fire.* If the boiler goes down in the middle of the winter, it will, of course, take a little longer to bring the system up to temperature, but the boiler won't be damaged.

On smaller applications on/off pump operations are the worst enemy. If we install a time clock, or outdoor reset, on a pump alone, we are doing no favors for the customer. When the pump has been off for any period of time, and it cycles on, we will dump cold water into the boiler. The boiler has to get shocked!

Some boiler manufacturers return the water to the bottom rear of the boiler. We should always return to the top of the boiler, and hopefully flow to the front first. The front of the boiler is the coolest as far as the fireside gases go. The top also has more space in *which* to mix the water before it hits the tubes and tube sheets.

It seems that some manufacturers are so tuned into steam boilers that they cannot simply reverse the inlet and outlet for a hot water boiler. Most manufacturers do reverse the tappings for hot water boilers, but there are still some that do not.

I sincerely hope that the day will come when this problem is realized by all parties involved and that we take better care, as a group, to give our customers what they deserve-a good quality job that will last for years, relatively maintenance free.