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Technical Bulletin

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Temperature and Pressure Relief Valves

"Providing for Michigan's Safety in the Built Environment"

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DETERMINING THE CAPACITY OF TEMPERATURE & PRESSURE RELIEF VALVES (ASME vs AGA)

Issue

Temperature and Pressure Relief Valves (T& P) are commonly rated by two separate organizations, the National Board of Boiler and Pressure Vessel Inspectors (National Board) and the American Gas Association (AGA). The National Board conducts capacity rating tests in accordance with Section IV of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Code. The AGA conducts capacity rating tests in accordance with ANSI Z21.22, Relief Valves and Automatic Gas Shut Off Devices for Hot Water Supply Systems.

These two capacity ratings appear as illustrated in Figure 1 on the valve nameplate. After examining this nameplate, it's easy to see why so many people have been confused by these ratings.

This technical bulletin will explain the difference in the rating systems and when to use each one.

Discussion

Construction and Operation of Temperature and Pressure Relief Valves

Unlike devices which are solely designed to relieve an over pressure condition, T&P valves have a dual purpose. First, they prevent the temperature within the vessel from rising above a specified limit (generally 210°F) and they also prevent pressure in the vessel from rising above a specified value. To satisfy these dual functions, the T&P valve incorporates two primary controlling elements: the spring and a thermal probe.

The spring tension keeps the valve seated until an overpressure condition causes the spring tension to be overcome and the valve disk is lifted off the seat and the excess pressure is relieved by the discharge of fluid from the vessel.

The thermal probe is designed to sense fluid temperature in the vessel and when this temperature exceeds a specified value, a plunger within the probe will push upwardly against the valve disk and cause it to open, thus discharging the fluid. This will cause the hotter fluid to be replaced by cooler fluid and reduce the temperature in the vessel causing the plunger to retract and allow the valve to reseat.

The concern for keeping the temperature below 200°F is to prevent a phenomena called "boiling liquid expanding vapor explosion" (BLEVE). This will occur upon failure of a vessel which contains water whose temperature is greater than 212°F at atmospheric pressure. As the vessel fails, the water flashes into steam and expands some 1570 times its original volume. This will cause devastating destruction and injury.

Rating Methods

AGA Rating:

The AGA Laboratory conducts rating tests in accordance with ANSI Z21.22, Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems. A T&P valve is mounted on a small vessel which is supplied with 15 psi steam. This exposes the thermal element of the T&P valve to steam at a temperature of 250°F. The discharge of the T&P valve is collected for 15 minutes and weighed. This is repeated on two additional sample T&P valves of the same manufacturer and the average discharge capacity is determined. This is adjusted to British Thermal Units (Btu's) per hour and the final AGA rating must not exceed 90% of the average discharge capacities in Btu's per hour as determined by the test.

National Board Rating:

The National Board Testing laboratory conducts rating tests in accordance with Section IV of the ASME Boiler and Pressure Code. As with the AGA, three sample valves are tested. However, these valves are tested for their function due to static inlet pressure alone; therefore the thermal probe is removed and replaced with dummy elements. Pressure is then increased at the valve inlet to 110% of the valves set pressure. The resultant discharge is averaged from the three valves and each valve's capacity must be within 5% of that average. The certified capacity would then be set at 90% of the calculated average.

Comparison of Ratings

These two methods are similar in that each require the testing of three valves and the capacity is based upon 90% of the average capacity determined for those valves. The primary difference between these rating methods remains with the pressure at which the valves are tested. For those valves whose set pressure is 150 psi, the National Board certified capacity is determined based on flowing the valve at 165 psi, where in comparison, the AGA rating is determined when the valve is opened due to the thermal element with a steam pressure of 15 psi. These flowing pressures differ by a factor of 10. From this, one can see why there is such a wide difference between these two ratings.

Conclusion

Proper Use and Sizing

Which rating to use must be determined by the specific application and jurisdictional authority. The ASME Boiler and Pressure Code bases its concept of over pressure protection on the premise that vessels constructed in accordance with this code will safely retain its pressure integrity up to 110% of the vessels maximum allowable working pressure. On the other hand, for those vessels that are not constructed to the ASME code,

prudence would dictate that maintaining the temperature below 212°F would be desirable to prevent the effects of a BLEVE. In either case, the sizing of the valve in Btu's is based upon the Btu input of the burner on the vessel as these relief valves must be capable of relieving all of the Btu's that the burner is capable of producing.

Questions regarding this technical bulletin may be directed to the Michigan Department of Energy, Labor & Economic Growth, Bureau of Construction Codes, Boiler Division, P.O. Box 30254, Lansing, MI 48909 or by calling (517) 241-9334.