

Boiler Safety & Relief Valves

Introduction

Boiler, boiler, toil and trouble. Not quite a Shakespearean verse, but equally dramatic is a company's boiler. At the turn of the 20th century, it was not uncommon to read about a tragic boiler explosion in the news, one resulting in the destruction of an entire building and loss of life to its occupants. Boilers have come a long way since then and are now equipped with a very important device to help protect against explosion - a safety valve or a relief valve. While these valves are designed to help protect boilers from over-pressure, which could result in an explosion, they still require periodic testing and maintenance. Failure to inspect, test and maintain these valves can have dramatic results. 27 people were killed, 72 were injured and nine were reported missing, when a huge explosion and fire, allegedly caused by a high pressure, steam boiler rupture, leveled Algeria's largest refinery complex on the Mediterranean coast. Estimated property damage: \$800 million (U.S.). Understanding the techniques to test and maintain safety and relief valves can help protect the boiler from an over pressure condition, helping to reduce the risk of property damage and personal injury.

The Safety Valve

A safety valve is a device that automatically relieves pressure and is actuated by pressure upstream of the valve. It is characterized by full opening pop action and is primarily used for gas or vapor service. This type of valve will fully open at a set pressure and remain fully open until the boiler pressure reaches a preset pressure. This preset pressure is set lower than the lifting pressure. The difference in pressure between lifting and closing is known as blowdown. Blowdown prevents the valve from repeatedly opening and closing rapidly (referred to as chatter) and damaging itself.



The Relief Valve

A relief valve is also a device that automatically relieves pressure and is actuated by the pressure upstream of the valve. However, it is characterized by gradual opening with the increase in pressure over the opening pressure and is primarily used for liquid service. This type of valve will gradually open at the set pressure and gradually close until the pressure in the boiler drops below the set pressure.



Safety/Relief Valves - Optimizing Operations

Safety and relief valves both require periodic testing to ensure that they are free to operate. Periodic inspections help to detect such conditions as leaking, dirt build-up, corrosion and physical damage of the body of the valve. Inspections during the testing of the device can reveal such problems as foreign material lodged on the valve seat, misalignment of the valve stem and weakening of the valve spring. The relief valve in the illustration above shows signs of continued long-term leaking. This results in the spring, which is located within the valve, being corroded. Corrosion typically causes the valve to either stick open, which can drain the boiler, or not open at all, or "freeze." In either case, the valve is considered non-functional. The boiler is not safe to operate in this condition and the valve should be replaced immediately.

The Valve Nameplate

Both the safety and relief valves provide important information on the nameplate, including capacity, set psi pressure, identification of the manufacturer, design, and year assembled/tested, and the ASME symbol. The nameplate must be securely fastened to the valve. The nameplate must remain on the valve and be legible. It is necessary to check the nameplate to verify whether the safety or relief valve is of sufficient size and set at a pressure to properly protect the boiler. If the nameplate is damaged so that it is illegible, is missing or tampered with, the valve should be tested and re-certified or a new valve should be installed. Safety valves will have wire seals placed on the adjustments that determine the set and reset pressures. Should the seal be broken, the valve is no longer considered safe to operate. It will need to be recertified by an organization with a VR (valve repair) Stamp. Only an organization with a VR Stamp can make repairs or adjustments to the valves including re-attaching a nameplate.

Inspecting and Testing

Testing of safety and relief valves should be conducted only by those properly trained to test the valves, since such testing can present hazards. When a valve is lifted, steam or high temperature fluid is released. Testers should take safety measures to protect themselves from the steam and the hazardous vapors and fluids. Jurisdictional requirements should be consulted prior to performing any testing.

A number of publications on the safe operation of safety valve testing should be referenced, including the Boiler and Pressure Vessel Codes of ASME [<http://www.asme.org/bpvc/>] and the National Board Inspection Code [<http://www.nationalboard.org>]. Companies also should document safety and relief valve testing, along with other boiler inspection and testing activities. These records can be helpful to the inspector at the time of the annual inspection.

Jurisdictional/Code Testing Requirements

Each state and some local "boiler jurisdictions" set certain requirements for testing frequency. Companies should check with the boiler jurisdiction or servicing inspector to be familiar with these requirements. Companies also should schedule boiler inspections with their boiler service providers or boiler insurance servicing engineers.

Safety/Relief Valves - Frequency of Testing

The National Board Inspection Code, among other things, makes the following recommendations on the frequency for testing safety and relief valves:

- High pressure steam boilers greater than 15 psi and less than 400 psi - perform manual check every 6 months and pressure test annually to verify nameplate set pressure.
- High pressure steam boilers 400 psi and greater - pressure test to verify nameplate set pressure every 3 years or as determined by operating experience as verified by testing history.
- High temperature hot water boilers (greater than 160 psi and/or 250°F) - pressure test annually to verify nameplate set pressure. For safety reasons, removal and testing on a test bench is recommended.
- Low pressure steam boilers (15 psi and less) - manually check quarterly and pressure test annually.
- Hot water heating boilers - manually check quarterly and pressure test annually.
- Water heaters - Manually check every 2 months. Due to the relatively low cost of safety valves for this service, it is recommended that a defective valve be replaced with a new valve if a repair or resetting is indicated.

Testing Safety/Relief Valves

Safety valves may be tested in one of three ways. Each has a different outcome. The three techniques include:

Operated In Place	Tested In Place	Bench Tested
<ul style="list-style-type: none"> • The National Board Inspection Code Section RB-3550 recommends a safety valve be checked for freedom of operation by activating the test or try lever in place. • This is performed with the boiler at a pressure of at least 75% of the set pressure stamped on the nameplate of the valve. • The test lever on the valve is then manually activated. • This method will ensure the valve opens and shuts tight but does not verify at what pressure the valve opens and shuts. 	<ul style="list-style-type: none"> • Testing a safety valve in place requires special test equipment and can only be performed by trained technicians. • This method is performed with the boiler shut down and under no internal pressure. • A stress is placed on the safety valve spring to simulate steam pressure. • Measurements of the stress applied and movement of the valve is used to calculate the actual pressure the valve will open. 	<ul style="list-style-type: none"> • Bench testing of a safety valve requires the valve to be taken off the boiler and sent to a valve repair organization holding a VR Stamp. • This method will accurately measure the pressure at which the valve opened and closed, and the amount of steam that the valve releases. • The VR Stamp holder will replace any worn parts, test the valve, and re-stamp the nameplate. • Bench testing is the most accurate method and is how both safety and relief valve are tested when manufactured.

Valve Discharge

Discharge from the safety or relief valve must be directed to a safe place. Missing discharge piping may result in property damage or personal injury if personnel are near the relief valve when it opens. The discharge piping should be:

- No smaller in diameter than the valve's outlet
- Non binding on the valves body which can lead to distortion and malfunction.
- Supported independently of the valve with adequate pipe supports.
- Equipped with drains to prevent condensation from accumulating on the valve seat and disc.
- Free of valves and obstructions.

Summary

The boiler's safety or relief valves are designed to help protect the boiler from damage should an over pressure condition develop. But, the first line of defense is the company's inspection activities to ensure the boiler and its component parts are in good operational order and well maintained. Proper maintenance and testing of these valves will ensure that they operate as intended. Not only are inspections required but inspections are key in helping companies maintain safe operation of the boiler and minimize any production downtime that otherwise could occur, if the boiler fails or is improperly maintained.

The safety and relief valves are important safety devices installed on boilers. To ensure their safe operation, they require periodic testing and maintenance by trained individuals. Periodic inspection and maintenance are important in a company's line of defense to help protect against unsafe boiler conditions.

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