NBIC Pressure Relief Device (PRD) Inspection Guide

This guide provides a basis for NBIC Inspectors use in reviewing Pressure Relief Devices (PRD's) for compliance with the *National Board Inspection Code* (NBIC). It is only intended to provide general guidance, and must be used in conjunction with NBIC, Part 2 for specific details of inspection.

1. Description and Overview

Pressure relief devices are used to provide a means of venting excess pressure which could rupture a boiler or pressure vessel. A pressure relief device is the last line of defense for safety. If all other safety devices or operating controls fail, the pressure relief device must be capable of venting excess pressure.

2. Types of Devices

There are many types of pressure relief devices available for use in the boiler and pressure vessel industry. This inspector guide will address the most common devices found on boilers and pressure vessels. Virtually all jurisdictions require a pressure relief device to be manufactured and certified in accordance with the ASME Code in addition to being capacity certified by the National Board.

The most common types of pressure relief devices are:

- Pressure Relief Valve – A pressure relief device designed for emergency or abnormal over pressure conditions and designed to reclose after the pressure has been reduced.
- Safety Valve – This device is typically used for steam or vapor service. It operates automatically with a full-opening pop action and recloses when the pressure drops to a value consistent with the blowdown requirements prescribed by the applicable governing code or standard.
- Relief Valve – This device is typically used for liquid service. It operates automatically by opening farther as the pressure increases beyond the initial opening pressure and recloses when the pressure drops below the opening pressure.
- Safety Relief Valve – This device includes the operating characteristics of both a safety valve and a relief valve and may be used in either application.
- Temperature and Pressure Safety Relief Valve – This device is typically used on potable water heaters. In addition to its pressure-relief function, it also includes a temperature-sensing element which causes the device to open at a predetermined temperature regardless of pressure. The set temperature on these devices is usually 210°F.
- Rupture Disk – This device is classified as nonreclosing since the disk remains open upon actuation. This type of device may be found in use with a pressure vessel where a spring-loaded pressure relief valve is inappropriate due to the

operating conditions or environment. They may also be used at the inlet or outlet of a pressure relief valve to isolate it from corrosive or clogging fluids.

- Pilot Operated Pressure Relief Valve- This is a pressure relief valve where the disk is held closed by system pressure, and this pressure is controlled by a pilot valve actuated by the system pressure.

3. Device Operation

Pressure relief devices must operate as designed in order to perform their required task. Different types of problems can prevent normal operation:

- The inlet piping connected to the device must not be smaller in diameter than the inlet opening of the device. An inlet pipe that is smaller than the device inlet opening could affect capacity or performance for which the device was designed.
- The discharge piping connected to the device must be no smaller than the discharge opening of the device. A discharge pipe that is smaller than the device discharge opening could cause pressure to develop on the discharge side of the device while operating.
- Multiple devices discharging into a discharge manifold or header is a common practice. The discharge manifold or header must be sized so the cross-sectional area is equal to or greater than the sum of the discharge cross-sectional areas of all the devices connected to the discharge manifold or header. Failing this requirement, the devices would be subjected to pressure on the discharge side of the device while operating. Even a small amount of pressure here could adversely affect the operation of the device. If back pressure is present or anticipated, a device designed for these conditions such as a bellows valve or balanced valve should be considered.
- Constant leakage of the device can cause a build-up of scale or other solids around the discharge opening. This build-up can prevent the device from operating as designed.
- Discharge piping connected to the device must be supported so as not to impart any loadings on the body of the device. These loadings could affect or prevent the proper operation of the device including proper reclosure after operating.
- Some devices, especially on larger boilers, may have a discharge pipe arrangement which incorporates provisions for expansion as the boiler heats up or cools down. These expansion provisions must allow the full range of movement required to prevent loads being applied to the device body.
- Drain holes in the device body and discharge piping, when applicable, must be open to allow drainage of liquids from over the device disk on spring loaded valves. Any liquid allowed to remain on top of the device disk can adversely affect the operating characteristics of the device.
- Most jurisdictional requirements state the device must be "piped to a point of safe discharge." This must be accomplished while keeping the run of discharge piping as short as possible. Most jurisdictions also limit the number of 90 degree elbows that may be installed in the discharge piping. Too long of a run and multiple elbows can adversely affect the operation of the device.

- For threaded valves, the outlet pipe should be positioned such that when the valve is discharging, the discharge forces will not tend to cause the valve to unscrew itself from its installation point.

4. Inspection Steps

Personal Protection Equipment

The inspection of pressure relief devices can include the discharge of high velocity and/or high temperature fluids, and high noise levels can be encountered. Appropriate personal protective equipment, such as eye and ear protection should be used as appropriate.

While inspecting a boiler or pressure vessel, the inspector will also be evaluating the pressure relief device(s) installed on, or associated with, the equipment. The inspector should:

- Compare the device nameplate set pressure with the boiler or pressure vessel maximum allowable working pressure (MAWP) and ensure the device set pressure does not exceed the MAWP. A device with a set pressure less than MAWP is acceptable. If multiple devices are used, at least one must have a set pressure equal to or less than the MAWP. The ASME Code should be reviewed for other conditions relating to the use of multiple devices.
- Ensure the device still has the device manufacturer's seals intact (may be the seal of an Assembler or Repair organization). These seals can be in the form of wire through a drilled hole with a soft metal button, such as lead, crimped on the wire, or removable parts may be stake punched or crimped to inhibit accidental movement. Any evidence of the seal mechanism being broken or destroyed could indicate tampering. If this is found, the inspector should require replacement of the device or repair by a qualified organization. Seal identification should match the original or repair nameplate as applicable.
- Verify the discharge of the device is piped to a safe point of discharge.
- If there are no records that pressure relief valve(s) have been tested, request the owner or owner's representative to lift the test lever, if so equipped. Section IV valves can have the test levers lifted without pressure in the boiler. All other valves must have at least 75% of the valve set pressure under the device disk prior to lifting the test lever. If the valve is found to be stuck in a closed position, the equipment **must** be immediately removed from service until such time as the valve can be replaced or repaired. This testing can be hazardous and needs to be done under carefully controlled conditions.
- Lifting the test lever of a spring-loaded valve may not be practical in all cases when inspecting pressure vessels. The contents of the vessel may be hazardous. In these cases, the vessel owner/user should have a testing procedure in place which will ensure documented inspection and testing of the device at regular intervals.

- The small pressure relief devices found on many air compressor vessels have a ring inserted through a drilled hole on the end of the device stem. These are tested by pulling the stem straight out and then releasing. The discharge openings in this type of device are holes drilled around the periphery of the device. These holes often get filled with oily dust and grit which can cause eye damage when the device is tested. A rag, loosely wrapped around the device when testing, can help prevent personal injury from the dust and grit.
- Valve body drains and discharge pipes should be free of debris or liquids.
- For valves equipped with a balancing bellows make sure the bonnet vent is not plugged.
- If a rupture disk is installed between a pressure vessel and a pressure relief valve, make sure there is a pressure gage or tell-tale installed. If there is any pressure showing on the gage, this means the disk has burst and must replaced.
- Detailed testing and operational inspection guidelines can be found in the *National Board Inspection Code*, Part 2 2.5.4 and 2.5.7.
- Recommended inspection and test frequencies can be found in the *National Board Inspection Code*, Part 2 2.5.8.

Additional Information

Additional information to aid inspections of pressure relief devices, including installation requirements, can be found in the following publications and sources:

- *National Board Inspection Code*
- ASME Section I
- ASME Section IV
- ASME Section VI
- ASME Section VII
- ASME Section VIII (Divisions 1, 2, and 3)
- ASME Section X
- ASME CSD-1
- Manufacturer's Installation, Operation, and Maintenance Documentation
- Jurisdictional Laws, Rules, and Directives
- API-576 Inspection of Pressure Relief Devices

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