

# Pressure Relief Device Inspection, Testing, and Service

## Introduction

What is a pressure relief device or PRD? Pressure relief devices protect pressure containing equipment such as boilers and pressure vessels from over pressurization that could lead to failure of the equipment and endanger personnel. These devices serve as the last line of defense typically after other high pressure alarms switches or other safety devices. If everything functions properly in the system the PRDs won't get used. They aren't part of normal operation and many plant owners and operators often don't think about them much once they are installed. When they are called upon to operate it is critical that they do so and as such proper care and maintenance are needed to ensure these safeguards are there for you when you need them the most.

The following discussion is meant to inform the reader of PRD maintenance and outline industry best practice.

Steps to be taken for care of these devices generally fall into three categories: Inspection, Testing, and Service. The following industry practice and guidelines are taken from the National Board Inspection Code (NBIC) created by the National Board of Boiler and Pressure Vessel Inspectors (NBBI). Owners of pressure containing equipment should always consult with their local jurisdictions and insurance companies for differing requirements.

<b>Inspect</b>	<ul style="list-style-type: none"> <li>• Most frequent</li> <li>• Service and environment dependent</li> </ul>
<b>Test</b>	<ul style="list-style-type: none"> <li>• Service and environment dependent</li> </ul>
<b>Service</b>	<ul style="list-style-type: none"> <li>• No more than every 3 test intervals or ten years, whichever is less</li> </ul>

## Inspection

The NBIC Part 2 Section 2.5.3 and 2.5.4 gives a set of inspection requirements to check out including but not limited to items such as:

- Checking ratings and nameplates to ensure the device is correctly sized for the application
- Looking for signs of leaks
- Checking for corrosion, erosion, and mineral buildup
- Inspecting for damaged parts
- Checking the surrounding piping and overall installation

The chapter lists additional requirements for specific applications like multiple boilers piped together, potable water heaters, rupture disks, etc.

These inspections are the most frequent activity to be done in monitoring the well being of these pressure relieving devices and can be conducted by the owner. A checklist/inspection form should be developed and filled out for record.

## Testing

Testing of PRDs periodically helps owners and operators to ensure the devices will not be kept from actuating for reasons that an inspection may not detect. For instance, a valve seat may be stuck closed due to mineral build up, corrosion, or failure of elastomeric parts not visible from the outside of the valve. There are a few different types of tests that range in level of involvement and useful results. The table below summarizes some pros and cons of the following tests mentioned in the NBIC:

- Set pressure test**- The PRD is exposed to more and more pressure until it is actuated. The pressure is measured and to verify that the valve opened at the predetermined design set pressure plus or minus the manufacturers published tolerance. This test can sometimes be done with the device left installed in the field but in some cases it is not practical to raise the pressure of the of the protected device to the PRD set pressure or it may be unsafe to do so. PRDs can also be bench tested by being removed from the protected equipment and mounted to a test contraption capable of introducing the necessary pressure repeatably and accurately measure the set pressure. These tests can be conducted by the owner or a qualified PRD repair shop (certification through NBIC is recommended).



Fig 1.A W/out Lever      Fig 1.B With Lever

- Lift/lever assisted set pressure test**- It is commonplace for steam relief valves to have hand levers that can be lifted to open the valve but most process relief valves do not contain hand levers. Figures 1.A and 1.B (inset left) show the difference between the two. If a lever is equipped, it can be used to conduct a set pressure test when it is not practical to subject the PRD to a pressure meeting or exceeding the set pressure. Force is applied to the lever until the PRD relieves the fluid. The force is measured, and the set pressure of the valve is verified by calculation given the internal pressure of the protected equipment, and the spring force and geometry of the PRD. This test can also be done by owner or qualified third party.

- Manual lever actuation**- The simplest test that can easily be conducted by the owner is to actuate the valve with the assistance of the manual lever (if equipped) to ensure the opening motion is not impaired.

This is referred to as checking the valve for “freedom to operate” and it ensures that the valve can lift but does not verify the set pressure at which it will lift as the lifting force is not measured in this method.

TEST TYPE	SET PRESSURE TEST	LIFT/LEVER ASSISTED SET PRESSURE TEST	MANUAL LEVER ACTUATION
<b>PROS</b>	<ul style="list-style-type: none"> <li>Best verification of set pressure</li> </ul>	<ul style="list-style-type: none"> <li>2<sup>nd</sup> best verification of set pressure</li> <li>Can be done in field without raising equipment pressure up to PRD set pressure</li> </ul>	<ul style="list-style-type: none"> <li>Simple to conduct</li> <li>Lowest cost</li> <li>Least downtime</li> </ul>
<b>CONS</b>	<ul style="list-style-type: none"> <li>Can be quite involved if PRDs need to be removed and bench tested</li> <li>Higher cost</li> <li>Higher downtime</li> </ul>	<ul style="list-style-type: none"> <li>Most complicated test procedure</li> <li>Only works for PRDs equipped with a lever</li> </ul>	<ul style="list-style-type: none"> <li>No verification of set pressure</li> <li>Only works for PRDs equipped with a lever</li> </ul>

See NBIC Part 2 Section 2.5.7 b), c), and e) for more information on these test methods.

Some PRDs may be cheaper to replace than have tested by a third party. Additionally, some devices may not be testable by construction. Consult the manufacturer to determine if this is the case.

## Service

The first two categories of Inspection and Testing do not give the user a complete understanding of the condition of the internal parts of the PRD. That is where the final and least frequent maintenance activity of service/repair or replacement comes in. During a service the valve will be completely disassembled. All the parts will be checked for signs of wear, the soft materials (like o-rings) will be replaced, and seating surfaces can be re-machined if showing signs of wear. Such repair activities should be conducted by a National Board certified “VR” certificate holder to ensure the process is undertaken to meet NBIC and manufacturer requirements to return the devices to “like new” conditions. Section 2.5.8.2 c) recommends service intervals be no more than three inspection intervals or ten years whichever is less. In many cases, a PRD will be cheaper to replace than to service at this time.

## Intervals/Frequency

The NBIC recognizes that the needed frequency of PRD maintenance activities is greatly dependent on the specific applications, the installations, the environment, the process conditions, and fluid properties, etc. A bare steel relief valve exposed to salty moist sea air and on a service with an abrasive fluid will show signs of wear much quicker than one on a clean, dry, inert gas mounted in an indoor climate-controlled location. As such the code gives recommended frequencies as a guideline but insists that experience/past inspections for each device or application should drive maintenance intervals. Table 2.5.8 in the NBIC lists the general recommendation by service type and is copied here for reference.

(21) **TABLE 2.5.8**

Service	Inspection Frequency
Power boilers less than 400 psi (2.76 MPa)	Lift lever test every six months, set pressure test annually or prior to planned boiler shutdown
Power boilers 400 psi (2.76 MPa) or greater	Set pressure test every three years or prior to planned boiler shutdown
High-temperature hot water boilers (See Note 1)	Set pressure test annually
Low-pressure steam heating boilers	Lift lever test quarterly, set pressure test annually prior to heating season
Organic Fluid Vaporizers	Remove, inspect, and set pressure test annually
Hot water heating boilers (See Note 2)	Lift lever test quarterly, set pressure test annually prior to heating season
Water heaters (See Note 3)	Lift lever test every two months, remove and inspect temperature probe for damage, buildup or corrosion every three years.
Pressure vessels/piping-steam service	Set pressure test annually
Pressure vessels/piping-air/clean, dry gas	Set pressure test every three years
Pressure vessels/piping-propane/refrigerant	Set pressure test every five years
Pressure relief valves in combination with rupture disks	Set pressure test every five years
All others	Per inspection history

## Planning/Implementation

So, what can you do to prepare to take care of these important safety devices in your plant? Here are some helpful tips to get you started:



### Design/Pre-Operation Phase

- Consult with local building authorities/jurisdictions and your insurance provider to determine any specific requirements for PRD maintenance
- Prepare a list of PRDs within your plant gathering information such as make, model, set pressure, service type, with hand lever or not, and begin to plan your initial inspection, testing, and service intervals based on those factors
- Gather or develop inspection procedures/check lists/forms
- Procure spares for PRDs that may need to be removed for testing and would cause considerable downtime
- For Designers/Engineers: Where possible design systems that allow ease of PRD testing in the field



### Operating Phase

- Train operations staff on inspection procedures
- In first year or two of operation look for qualified third-party repair and test facilities in your area. Your PRD manufacturer may have own network of service partners
- Procure spares as needed if not already done
- Plan ahead to consolidate downtime with other work needed at the plant
- Review results of inspections and tests and adjust intervals as needed

## Additional Resources

### **Repair Shops**

#### Control Associates

- An Emerson Impact Partner serving the Northeast and Midatlantic
- <https://www.control-associates.com/services/lifecycle-services/shutdowns-turnarounds-outages/pressure-relief-safety-valve-services/>

#### Bay Valves

- NB Certified VR shop headquartered in Seattle serving the Northwest
- <https://bay-valve.com/valves-shop-service/#tab-id-3>

#### North American Safety Valve Industries, Inc

- Kansas City MO
- <https://nasvi.com/>

### **Manufacturer Examples**

- Farris: Has localized authorized service providers
- Lesser: Has Lesser Authorized Repair Center (LARC)
- Kunkle (Emerson): Has Emerson impact partners