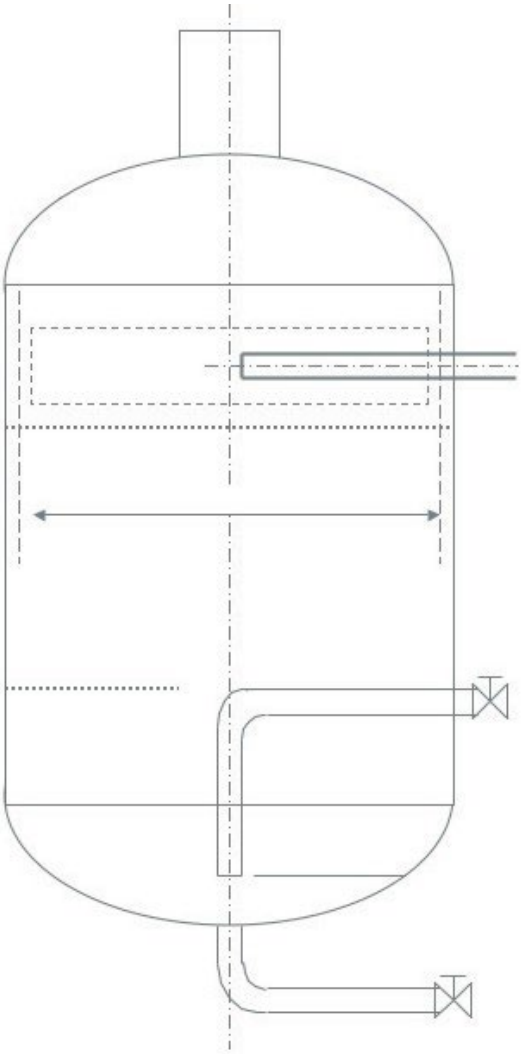
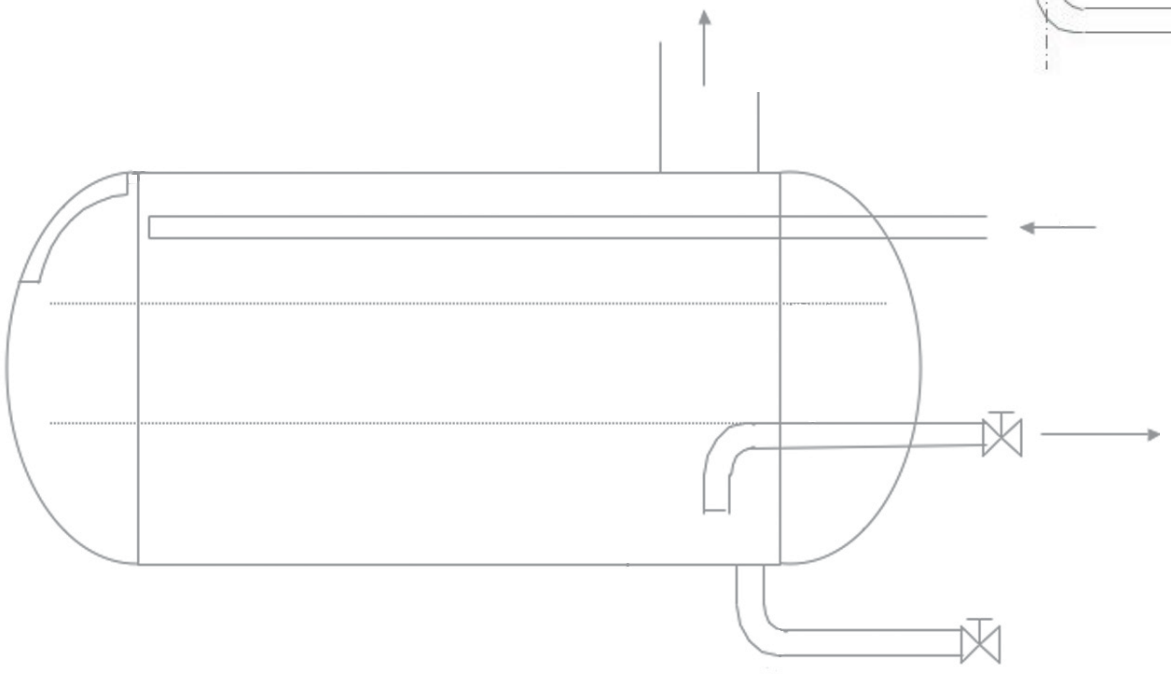
NB-27,
Guide for Blowoff Vessels
2024 Edition,
Rev. 0





National Board Task Group on the NB-27, *Guide for Blowoff Vessels*
2024 Edition, Rev. 0

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Introduction

The intent of this publication is to provide design considerations and guidance for boiler blowdown systems. It does not address all possible arrangements for boiler blowoff equipment. Where the design of boiler blowoff equipment is not addressed in this publication, guidance should be obtained from the manufacturer's requirements, competent engineering firm, or inspection authority of the jurisdiction in which the equipment is installed.

The words "shall," "should," and "may" are used throughout this guide and have the following intent:

- Shall – action that is mandatory.
- Should – indicates a preferred but not mandatory means to accomplish the requirement, unless specified by other sources, such as the jurisdiction.
- May – permissive; not required or a means to accomplish the specified task.

The NB-27 references the requirements of the "jurisdiction." Where any provision herein presents a direct or implied conflict with any jurisdictional regulation, the jurisdictional regulation shall govern.

Boiler water treatment is an integral part of boiler operation, used to control scaling, corrosion, and deposits. Boiler water treatment often leads to the formation of solid particles that are initially dissolved or suspended in the water. Solids concentrated in boiler water tend to promote foaming and scaling, resulting in carryover and loss of heat transfer. This may cause contamination of downstream piping and equipment and overheating of the boiler heating surfaces. Proper chemical treatment of boiler water includes use of a sludge conditioner; this promotes precipitation of the solids, allowing them to settle to the bottom of the boiler, forming sludge. Bottom blowdowns help maintain proper water chemistry by removing sludge from the lower portion of the boiler.

It is not uncommon for the terms “blowdown” and “blowoff” to be used interchangeably in the boiler industry. The resulting confusion has led to extensive research on the history of these terms, leading to the rewrite of this guide. As for the history of these terms, the term “blowdown” was used exclusively in the U.S. Navy, but this could not be said for the boiler industry. The terms “blowdown” and “blowoff” originated from two separate industries. The term “blowdown” came from boiler plant operators and water chemistry professionals; it refers to the system and act of blowing down the boiler to maintain water chemistry. The term “blowoff” originates from blowdown system designers and pertains to the individual components of a blowdown system. Examples include blowoff piping, valves, and tanks. With such differences in meaning, the terms should not be used interchangeably. Within this guide, “blowoff” will refer to the equipment used to blowdown the boiler, and “blowdown” will refer to the act of blowing down the boiler.

Blowdowns shall be performed in accordance with the boiler manufacturer’s requirements and when applicable, with jurisdictional requirements.

There are three basic types of boiler blowdowns:

- **Bottom blowdown** is typically an intermittent blowdown, which lowers the water level by a few inches. A bottom blowdown removes water, along with sludge that has accumulated in the boiler’s lowest point(s). In the case of watertube boilers, this includes blowing down all lower headers, including the mud drum, to remove sludge.

- **Water level control or column blowdown** is performed to ensure the boiler water level control and safety devices operate properly. This is performed by removing boiler water from the external housing of the water column and initiating a boiler shutdown. The column blowdown is also intended to remove sludge that accumulates in the external housing and piping of the water column.

- **Surface or continuous blowdown** is used to remove impurities and total dissolved solids by skimming the surface of the water as a means of controlling the concentration of solids in the boiler water. The surface blowoff piping is typically located just below the boiler’s normal operating water level.

While bottom blowdown and surface blowdown are intermittent operations, continuous blowdown is, as the name suggests, a continuous process that is typically an automatic operation utilizing a regulating valve or orifice. The frequency and type of blowdown should be based on recommendations of the boiler manufacturer and the boiler’s associated water chemical professional; the frequency and type of blowdown are also based on the chemical analysis of the boiler water. Bottom blowdown of some boiler designs, especially watertube boilers in operation, is not advised as it can affect boiler circulation and

may be dangerous. Unless otherwise stated by the boiler manufacturer, bottom blowdown should be performed when the boiler is up to operating pressure with minimal to zero steam demand. The boiler should not be fired during the bottom blowdown process. Water column blowdown shall be performed in accordance with the manufacturer's recommendations. When boilers are operated at or near rated capacity, the circulation is significant enough that the mud and sludge are not at risk of settling.

The primary function of the blowdown system is to provide a safe means of removing contaminants from the boiler's water, thus preventing sediment accumulation in the bottom portion(s) of the boiler. This includes reducing the pressure and temperature to limits that allow the water to safely discharge into a sewer, drain system, or other designated area. The usual practice is to discharge the blowdown water into a vented vessel where it can cool naturally or to add cold water to reduce the temperature and pressure of the blowdown water to acceptable discharge levels.

Discharge of high-temperature water from a boiler blowdown system can be hazardous to personnel and may damage sewers or drains. The pressure of the water discharged from the blowdown system into sewers or drains shall not exceed 5 psi (34 kPa). Typically, the maximum acceptable water temperature for discharge into a sewer system is 140°F (60°C). The Environmental Protection Agency or local ordinances may require lower temperatures.

There are two basic types of tanks used in blowdown systems:

- **Blowoff Separators –** These units are usually equipped with an aftercooler. These separators are designed to flash as much of the water into steam as possible and then vent the steam at a safe point of discharge. This process minimizes the amount of hot water remaining. After the steam is vented, the remaining hot water is drained through the aftercooler, which uses cooling water to quench the hot water to a safe temperature. The installation of a baffle in the aftercooler will assist in mixing the two liquids. The quenched water is then piped to a sewer or drain system. The main advantages of blowdown separators are their small size and cost. If a boiler operating pressure exceeds 300 psi (2.10 MPa), the use of a blowoff tank (described below) should be considered.

- **Blowoff Tanks –** These tanks are similar to blowoff separators but are typically much larger and are sometimes designed to hold the blowdown water remaining after the flash steam is vented. These tanks use natural convection to allow the collected water to cool to an acceptable temperature before the next boiler blowdown. When the next blowdown is released from the boiler to the tank, the hot blowdown water mixes with the previous blowdown water. This previous blowdown water is the remaining water that did not reach the tank's overflow drain. Since this previous blowdown water has now cooled, it should quench the entering hot blowdown water, resulting in a mixed temperature of ≤140°F (≤60°C). The blowoff tank's water level then rises out of the overflow drain. The advantage of this type of blowdown is that it may not require cooling water. The size of the blowoff tank, quantity of boilers, and frequency of blowdowns will determine the need for incorporating an aftercooler. The advantage of larger blowoff tanks is that they may remove the need to mix the water discharged to the sewer or drain system with cold water.

Components of the system shall be designed to withstand shock loading conditions. As a result, the piping shall be adequately supported and designed with large radius bends. All piping to and from the blowoff vessel, including the lines listed below, shall be designed in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPV Code) Section I,

Section IV, and B31.1, as applicable. The blowoff vessel shall be manufactured in accordance with the ASME BPV Code, Section VIII, Division 1, for a maximum allowable working pressure (MAWP) of ≥50 psi (≥345 kPa) or in accordance with the boiler manufacturer's recommendations and when applicable, with jurisdictional requirements.

Blowoff vessels should be fitted with the following connections and appliances as appropriate:

- Blowoff line inlet
- Water outlet
- Vent
- Drain
- Inspection openings
- Pressure gage
- Thermometer
- Site glass or alternative level-indicating device
- Cold water supply

The vent size determines the pressure rise within the vessel to a large degree. The vent shall be of sufficient size to release the flashing water (steam) that occurs during blowdown.

The vent connection shall be in the uppermost part of the vessel, open to the atmosphere without intervening stop valves, and vented to a "safe point of discharge" as defined in the NBIC Glossary of Terms. The vent piping shall be at least full size until the point of termination. The connection may be vertical, and no rain cap is necessary.

Scale and sediment from the blowdown water will be deposited in the blowoff tank. The vessel shall be drained and cleaned at a frequency that will prevent sediment accumulation from obstructing the vessel outlet. A drain connection shall be provided. The drain shall contain fittings that facilitate cleaning. Valves and piping installed on the drain connection shall have an internal cross-sectional area not less than the full area of the vessel's outlet connection.

For multiple boilers to blowdown consecutively to a single blowoff vessel, an automatic cooling water control device shall be attached to the blowoff vessel, or a water discharge line allowing cold water to be added to the blowdown water, reducing the temperature to ≤140°F (≤60°C).

Use of multiple blowoff vessels (i.e., more than one vessel or receiver used in a boiler blowoff line to reduce the temperature and pressure of the blowdown water) is permitted. Multiple vessel systems usually consist of a receiver or separator that discharges into one or more additional receivers, heat exchangers, sumps, or cooling ponds before flowing to a sewer or other point of discharge.

Closed blowoff vessels are permissible provided they are constructed in accordance with ASME BPV Code Section VIII, Division 1, for an MAWP at least equal to the MAWP of the boiler to which they are connected.

Blowdown heat recovery systems and flash tanks are also permissible.