

WATER AGENCIES' STANDARDS

Design Guidelines for Water and Sewer Facilities

SECTION 8.1 PRESSURE/FLOW CONTROL STATIONS

8.1.1 PURPOSE

This section provides guidelines for the use, location and design of pressure/flow control stations.

8.1.2 STANDARD TERMS AND DEFINITIONS

Wherever technical terms or pronouns occur in these guidelines or in related documents, the intent and meaning shall be interpreted as described in Standard Terms and Definitions.

A. Definition

Pressure/flow control stations serve the following functions:

- Regulating/reducing (PRV) stations maintain constant downstream pressure regardless of changing flow rates and/or varying inlet pressures. They are typically used to supply an area of lower pressure from an area of higher pressure. In general, PRV Stations shall be required on the distribution system when the static system pressure exceeds 200 psi, and when the intent is to create a new pressure zone. PRV Stations shall be designed to carry the low and peak flows.
- Sustaining stations throttle flow rate when the upstream pressure approaches the set pressure on the upstream side of the station and close completely if the set pressure cannot be maintained. They are typically used to prevent demands in an area of lower pressure from depleting the pressure in the area supplying it.
- Relief stations maintain constant upstream pressure by relieving flow (and excess pressure) to the downstream system. They are typically used to prevent pressure surges in pumped, closed, or failed systems.

8.1.3 GUIDELINE

It is the responsibility of the user of these documents to make reference to and/or utilize industry standards not otherwise directly referenced within this document. The Engineer of Work (Engineer) may not deviate from the criteria presented in this section without prior written approval of the agency's representative.

A. Locations of Pressure Control Stations

Pressure control stations are located within Agency owned property, the public right-of-way and easements granted in perpetuity to the Agency, but not in vehicular corridors or curbside parking areas. Vaults should be placed within the easement to allow for vehicular access to the site. The minimum easement area should provide for at least a 6 foot by 6 foot vault along with vehicular access on at least one side. If at all possible, access hatches are located away from normal pedestrian paths (e.g., behind sidewalks). Planning documents shall designate the approximate locations based on Agency master planning and available Master Plans. Any locations other than those described above must be by prior approval of the Engineer.

In evaluating the need or site for a pressure control station, extreme care must be taken to ensure that all hydraulic standards within each of the connected pressure zones is maintained at all times. This is especially important in the case of pressure regulating/reducing stations where the potential to deplete the hydraulic energy of the upstream area is particularly acute. In the specific case of a pressure relief station, particular care should be taken to ensure that the downstream area and pipeline grid can accommodate the variable influx of flow, usually highest during low demand periods.

Unless inhibited by physical or hydraulic barriers, or if operational improvements and annual cost savings can be identified, pressure regulated/reduced areas may not receive primary service from pumped areas. Emergency connections are the exception. However, such emergency connections must be analyzed to ensure that emergency flows do not overwhelm the capacity of the pumps or the capacity of the pipeline grid supplying the emergency connection.

B. Configuration and Sizing Criteria

Pressure control stations must be designed to handle maximum, minimum and emergency (including fire) demands. The highest static pressure to be provided at any customer service anywhere within the system is 200 psi. Pressure relief valves to protect the water system should be set 15 psi above the normal maximum pressure at each mechanically operated source such as a pump station or pressure control station. The pressure class of the water main pipe at any elevation is dictated by this relief valve setting.

Pressure reducing valves are hydraulically operated automatic control valves that control the downstream pressure in a water distribution system. The valves are typically diaphragm actuated globe or angle valves. The PRV has a pilot control valve that senses the pressure at the outlet of the main valve. The pilot valve modulates to open or close the main valve cover diaphragm which causes the main valve to modulate and maintain a constant downstream outlet pressure regardless of the upstream pressure. PRVs shall include components that provide pressure sustaining control on the upstream side of the valve. The PRVs shall sustain the upstream pressure at a minimum of 60 psi during peak demand. The designer shall specify the operating range for pilot control valves that operate the PRV and the pressure-sustaining valve.

In pressure zones supplied by more than one pressure control station (without available storage), each station is sized so that anyone of the pressure control stations can be totally removed from service without reducing the overall maximum supply capacity to the entire pressure zone. This requirement shall also take into account the capacity of the water system to deliver the needed water to all areas of the pressure zone from the remaining operable pressure reducing stations.

In general, large pressure control valves (greater than 10 inches nominal size) may not be used to handle both maximum and minimum flows. Small pressure control valves, not less than 4 inches nominal size, are used to handle minimum flows.

All pressure regulating/reducing valves must be equipped with a check valve feature to protect against undesired backflow due to a failed pressure regulating/reducing valve in another part of the same pressure zone. Each pressure regulating station should include a bypass line of an equal or greater diameter than the supply line to the station and an adequate high-pressure relief valve to protect the regulated water system.

Pressure control stations must be equipped with one more than the number of pressure control valves required for the maximum design pressure. In general, this means that:

- Larger capacity pressure control stations containing pressure control valves, 10 inches and larger, are designed for not less than three pressure control valves: one or more duty valves for the anticipated maximum flows, one backup valve equal in size to one of the duty valves, and one low-flow valve for the anticipated minimum flows.
- Smaller capacity stations containing pressure control valves, 8 inches and smaller, are designed for not less than two pressure control valves: one duty valve for the anticipated maximum and minimum flows, and one backup valve equal in size to one of the duty valves.

Pressure control valves must be housed within a concrete vault, either pre-cast or cast-in-place, with a minimum inside vertical clearance (floor to roof) of 5 feet. The valves must be elevated and supported by appropriate means (see Figures 8-1-1, 8-1-2) with their center lines at least 2 feet above the finished floor elevation. All pressure control valves in the vault must have not less than 2 feet of clear distance between the valves. The designer shall review the flow ranges for the PRVs in order to minimize the number of PRVs at a pressure reducing station. Every effort shall be made to design a PRV station that has two valves.

Typical PRV Stations shall conform to the schematic layout shown in Appendix A.

In general, pressure control valves are aligned so that all associated piping passes perpendicularly through the walls of the vault. For large-pressure control stations, where thrust conditions from pressure and/or flow may dictate special design, the alignment of pressure control valves may be skewed (e.g., 45 degrees) to the walls of the vault. However, these special designs must be approved by the Engineer.

All connected water conveying equipment and appurtenances within the walls of the vault must be flanged except at the flexible coupling on one side of the pressure control valve, which must be restrained.

Each pressure regulating valve must be isolated by gate or butterfly valves on both sides. Each pressure reducing station shall include a bypass line of equal diameter to the supply line feeding the PRV station. Pressure relief discharge requirements should be considered.

Pressure reducing valve stations shall have 2 pressure reducing valves, 1 sized for low demand flows and the other designed for peak flows. Each PRV shall have its own supply connection on the inlet manifold.

The maximum continuous flow velocity through the PRV shall be 20 feet per second (fps), or the manufacturer's recommended velocity, whichever is lower. The minimum continuous low flow velocity shall be 2 fps.

Pressure class 150 PRVs shall be used where the static system operating pressure is less than 140 psi. Class 300 PRVs shall be used where the static system operating pressure is 140 psi or above.

Cement Mortar Lined and Coated steel pipe shall be used for PRV stations between connection points to the distribution mains. Mortar coating shall be omitted on above grade piping and piping within the PRV vault and epoxy coating used instead.

Depending upon the exact use for a regulating station, flow metering should be considered. Flow metering will allow flows to be monitored for a variety of reasons to include water sales to other agencies, transfers to other agencies whether directional or bi-directional metering devices are used and tracking flows for accountability of inventory.

C. Appurtenances

Pressure control stations must have a by-pass line of equal or greater size than the supply line to the station, with an in-line gate or butterfly valve that remains closed during normal operating conditions. Appropriate thrust restraint against the closed valve must apply.

Each pressure control valve must be isolated on either side by gate or butterfly valves. In general, the isolation valves are located outside the vault, buried with risers to the ground surface and valve covers per applicable standard drawing(s). Each control valve must have a pressure gauge upstream and downstream of the valves to assist operators in setting the control valves.

Pressure reducing stations shall be located within the public right-of-way or in an easement. In most cases, the pressure reducing valve station will be too large to fit in the area between the sidewalk and the R.O.W. and an easement will be required. Other special locations shall only be allowed by prior approval from the individual agency.

Pressure reducing valve vaults shall be in accordance with the WAS, or as approved by the agency. The floor of the vault shall be a finished concrete slab with an 18" x 18" x 18" sump located below an access hatch accessible to portable pumping equipment. Water should be pumped out of the sump via outside piping. The centerline of the pressure reducing valves shall be approximately 2.5 feet above the finished floor. On larger diameter pipes (24" and greater) provide a minimum of 1-foot clearance between the bottom of the PRV and the floor. PRV vaults shall have an inside clear height of 7-feet. The vault cover shall be a spring loaded, hinged, aluminum access hatch capable of being operated by one person. Vault covers shall be designed to withstand continuous H-20 traffic loadings if they are within heavy traffic areas. Vaults that are able to be located outside high traffic areas and are within easements with occasional work traffic should use the intermittent H-20 designation. The wheel live load shall be 16 KIPs. H-10 vaults may be allowed with prior approval of the agency. Vault covers (access hatches) must be hinged and spring-assisted to accommodate "one person operation," must have hold open stay bars and safety railings when doors are in the open position, and must be designed to withstand continuous H-20 traffic loadings. Any individual cover panel must not be longer than 8 feet in any direction.

Pressure reducing stations shall be equipped to monitor pressures with high side and low side pressure charts. Conduit stub-outs for the installation of SCADA monitoring and control equipment shall be included in the design of all new pressure reducing stations. Pressure reducing and backpressure sustaining valves shall be set at 50 psi – 60 psi. Agency staff shall set pressure for all control valves.

Ladders in vaults must be equipped with retractable safety extension devices per OSHA requirements.

All aboveground exposed piping, valves, and valve covers for recycled water PRV stations shall be painted OSHA Safety Green.

All piping within a recycled water PRV vault shall be painted purple.

On the exterior lid of the recycled water PRV vault, stencil the words "RECYCLED WATER PRV" and the upper and lower pressure zone designations (i.e., "980/760").

D. Materials

Pressure control valves, piping, isolation valves, and all other appurtenances associated with pressure control stations must conform to the appropriate Agency's Approved Materials List.

Concrete vaults must be designed to accepted engineering standards with a 28-day concrete compression strength of not less than 4,000 psi. Prefabricated vaults within these same design parameters are acceptable. In high ground water situations, the vault may not rely on restraint from protruding pipes or other appurtenances to mitigate buoyancy.

E. Instrumentation and Control

Critical pressure control stations must be equipped with telemetry equipment on both the high and low-pressure sides of the pressure control valves in accordance with these Guidelines and at the direction of the Engineer. The Engineer must coordinate power supply details and phone modem, if applicable, with utility companies.

Suggested pressure settings for the pressure control valves must be noted on the construction drawings, with the additional notation: "Subject to change based on actual field operating conditions."

END OF SECTION

Figure 8-1-1

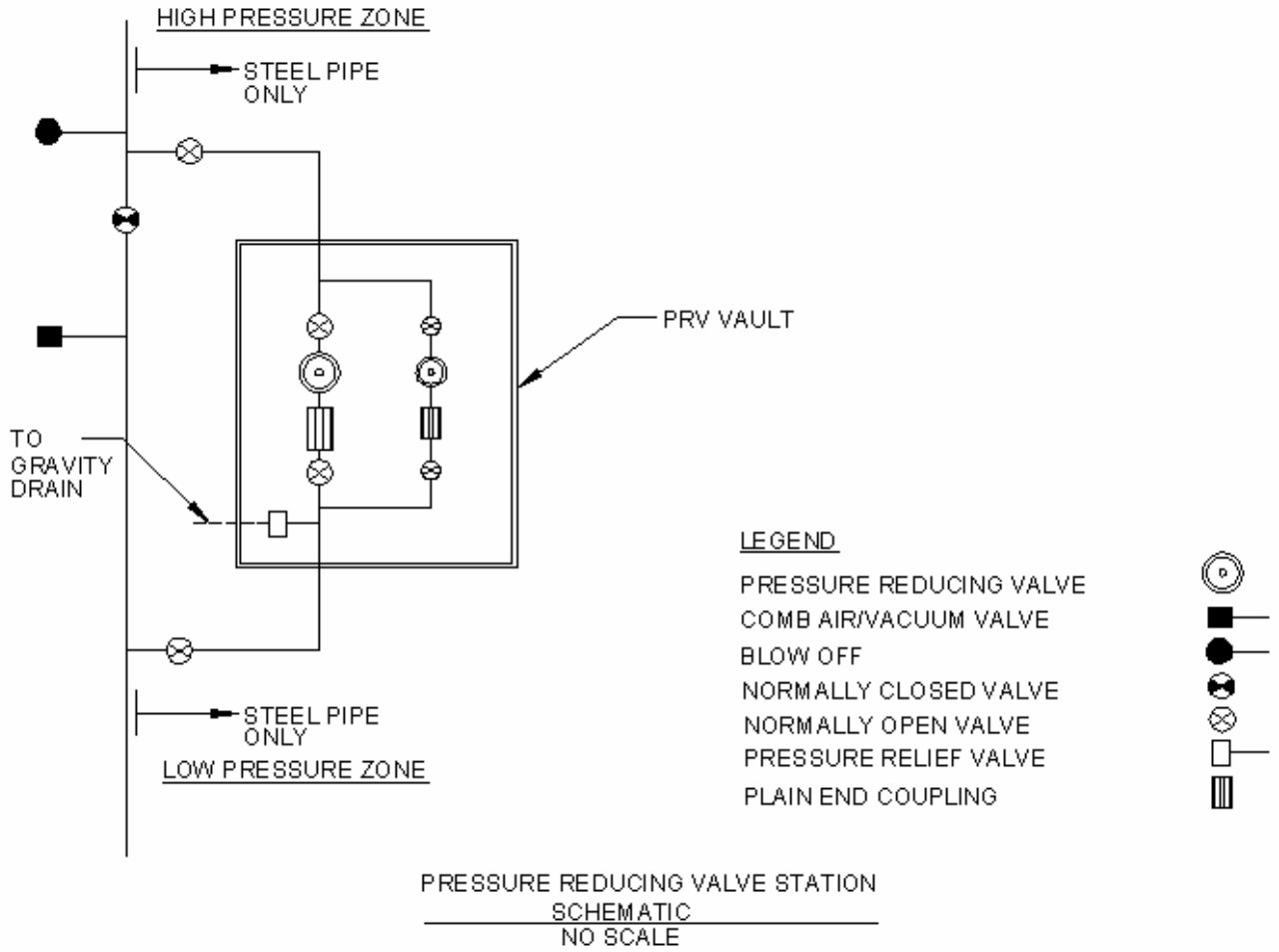


Figure 8-1-2

