TOP 100 PRESSURE RELIEF VALVE QUESTIONS & ANSWERS

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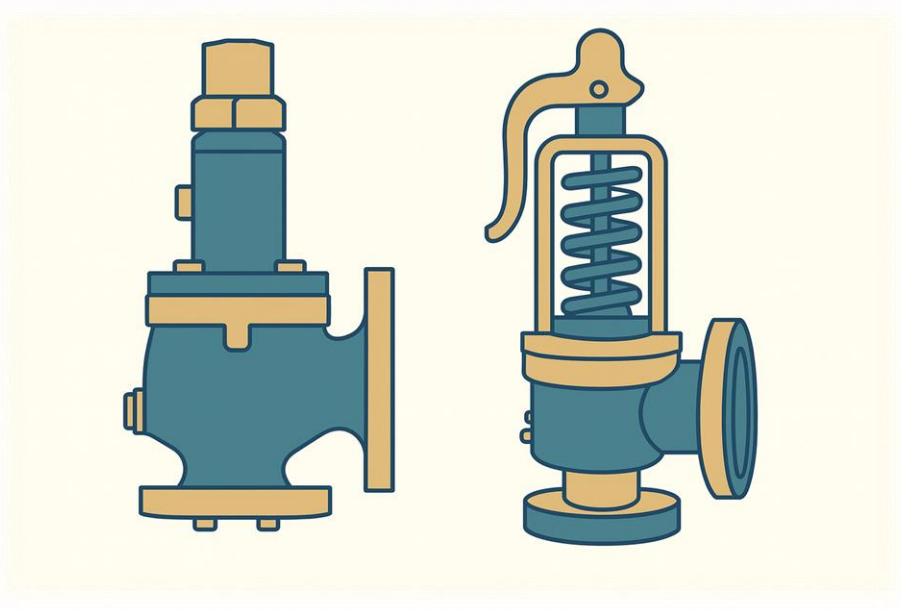

I. PRV Fundamentals, Definitions, and Design

1. **Question: What is the fundamental purpose of a Pressure Relief Valve (PRV)?**
   Answer: The primary purpose of a PRV is safety. It is a self-actuated device designed to:
   a. **Protect Equipment:** Safeguard a pressure vessel or system from exceeding its **Maximum Allowable Working Pressure (MAWP)**.
   b. **Discharge Fluid:** Automatically open and discharge fluid when an **overpressure** condition is reached.
   c. **Reclose:** Automatically **reclose** and prevent further flow after the pressure has returned to a safe operating level.

2. **Question:** Differentiate between a Safety Valve (SV), a Relief Valve (RV), and a Safety Relief Valve (SRV).
   Answer: The primary difference lies in the service fluid and opening characteristic: a. **Safety Valve (SV):** Used for **compressible fluids** (gas, vapor, steam). Characterized by a rapid, full-opening, or "**pop**" action.
   b. **Relief Valve (RV):** Used for **incompressible fluids** (liquids). Characterized by a **gradual opening** proportional to the pressure increase over the **set pressure**.
   c. **Safety Relief Valve (SRV):** Suitable for both, exhibiting pop action in vapor service and proportional action in liquid service.

3. **Question:** Define Set Pressure, MAWP, and Operating Pressure.
   Answer: These are key pressure terms for any pressurized system:
   a. **Set Pressure:** The inlet static pressure at which the PRV is adjusted to **open**. It is typically equal to the **MAWP** of the protected equipment.
   b. **MAWP (Maximum Allowable Working Pressure):** The maximum gauge pressure permissible in a vessel at a specified temperature.
   c. **Operating Pressure:** The pressure at which the protected system normally functions. It should be significantly lower than the Set Pressure (typically ≤90%) to prevent **valve simmering**.

4. **Question:** Explain the terms Overpressure and Accumulation.
   Answer: Both terms describe pressure conditions above the set point during a relief event:
   a. **Overpressure:** The pressure increase **above the set pressure** required for the PRV to achieve its full rated capacity/lift (typically limited to 10%).
   b. **Accumulation:** The maximum pressure reached in the vessel during the relieving process, expressed as a percentage of **MAWP**. Code limits usually range from 10% to 21% (for fire cases).

5. **Question:** What is **Blowdown**, and how is it typically controlled in a conventional valve?
6. **Answer:** Blowdown is a measure of valve stability and sealing:
   a. **Definition:** The pressure difference between the set pressure and the **reseating pressure**, expressed as a percentage of set pressure.
   b. **Control Mechanism:** It is primarily controlled by adjusting the position of the **nozzle ring** (or popping ring), which changes the fluid dynamics around the disc to ensure a stable, positive closure.

I. PRV Fundamentals, Definitions, and Design (Cont.)

6. **Question:** Describe the operation of a **Conventional Spring-Loaded PRV**.
   Answer: The operation relies on a force balance:
   a. **Seating Phase:** The spring force acts on the disc, holding it closed against the upward force of the system pressure.
   b. **Initial Lift (Simmer):** When system pressure equals the **set pressure**, the forces balance, and the valve begins to lift.
   c. **Pop Action:** The fluid enters the **huddling chamber**, and the pressure acts on a larger disc area, creating a sudden, high force that overcomes the spring, resulting in the rapid, full-opening "**pop**."

7. **Question:** What are the key advantages and disadvantages of a **Conventional PRV**?
   Answer:
   a. **Advantages:** Simple design, robust, low initial cost, and easy maintenance.
   b. **Disadvantages:** Set pressure is directly affected by **back pressure**, requires a large differential between operating and set pressure (typically ≤90%), and is prone to **chattering**.

8. **Question:** Why and when is a **Balanced Bellows PRV** used?
   Answer: The balanced design is used to overcome back pressure limitations:
   a. **Purpose:** Used when the discharge **back pressure is high or variable**.
   b. **Mechanism:** An impervious **bellows** isolates the spring and bonnet from the discharge pressure, ensuring the **set pressure remains independent** of back pressure variations.

9. **Question:** Explain the principle and main benefit of a **Pilot-Operated Relief Valve (PORV)**.
   Answer: PORVs utilize a separate control mechanism:
   a. **Principle:** The main valve is held closed by system pressure applied to the top of a piston, controlled by a small, precise **pilot valve**. b. **Main Benefit:** Allows a much higher operating pressure (up to **98% of set pressure**) and achieves superior seat tightness and set point accuracy.

10. **Question:** What is the critical failure mode of a PRV?
    Answer: The most dangerous failure mode is **Failing to Open (Sticking Shut)**. a. **Danger:** If the valve fails to lift, the vessel pressure will continue to rise above the MAWP, leading to **catastrophic rupture**. b. **Causes:** Common causes include corrosion, fouling, seizing of the disc/guide, or a blocked inlet line.

11. **Question:** What is "**Choked Flow**" and how is it related to PRV sizing?
    Answer: Choked flow, or critical flow, is a maximum flow condition for compressible fluids: a. **Definition:** Occurs when the velocity of a gas or vapor through the orifice throat reaches the local **speed of sound**. b. **Sizing Relation:** The flow rate is calculated assuming choked flow because this represents the **maximum possible mass flow rate** for a given upstream pressure, which must be the basis for sizing the orifice.

12. **Question:** What is the **3% rule** for inlet pressure drop, and why is it vital?
    Answer: This rule is critical for valve stability:
    a. **Rule:** The non-recoverable pressure drop in the inlet piping must not exceed **3% of the set pressure** at rated flow (API 520).
    b. **Vitality:** Exceeding 3% causes pressure loss beneath the disc after opening, leading to destructive **chatter** (rapid cycling) and mechanical failure.

13. **Question:** How does the **discharge coefficient (Kd)** factor into PRV sizing? **Answer:** The Kd is used to convert theoretical capacity to actual capacity:
    a. **Definition:** Kd is the experimentally determined coefficient that accounts for **flow losses** due to friction and turbulence through the nozzle.
    b. **Use:** It is applied to the theoretical flow equation to calculate the actual certified relieving capacity. For certified vapor PRVs, Kd is typically **0.975**.

14. **Question:** What is the typical difference between the PRV inlet and outlet flange size, and why?
    Answer:
    a. **Size Difference:** The outlet flange is typically **larger** than the inlet flange (e.g., a 2x3 or 6x8 valve).
    b. **Reason:** As the fluid depressurizes, its volume increases rapidly. A larger outlet connection is required to maintain low flow velocity and minimize the **built-up back pressure** in the discharge piping.

15. **Question:** What is the maximum allowed **set pressure tolerance** for PRVs per ASME?
    Answer: The tolerance applies to the *as-tested* set pressure: a. **For Set Pressures ≤70 psig:** The tolerance is **±2 psig**. b. **For Set Pressures >70 psig:** The tolerance is **±3% of the set pressure**.

16. **Question:** Differentiate between **Built-up Back Pressure** and **Superimposed Back Pressure**.
    Answer: Both contribute to the total pressure at the valve outlet:

a. **Superimposed Back Pressure:** The static pressure existing at the valve outlet flange **before** the valve opens (e.g., pressure from a common header).
b. **Built-up Back Pressure:** The pressure that develops at the valve outlet flange as a result of the valve **flowing fluid** through the discharge piping system.

17. **Question:** What is the material selection criteria for **PRV trim**?
Answer: Trim materials (nozzle, disc, seat) are crucial for reliability and longevity:
a. **Corrosion Resistance:** Must be compatible with the chemical nature of the process fluid.
b. **Erosion Resistance:** Must withstand the high-velocity flow during relieving (e.g., using **Stellite** or hardened stainless steel).
c. **Hardness/Galling Resistance:** Must maintain seating integrity and resist wear from movement (galling).

18. **Question:** What is the function of the PRV **huddling chamber**?
Answer: The huddling chamber is a feature of the conventional safety valve design: a. It is a recessed chamber formed by the disc and nozzle ring when the valve initially lifts.
b. It captures the relieving fluid, which then acts on a larger surface area (the disc's lip), rapidly increasing the opening force.
c. This force increase generates the sudden, full "**pop**" action.

19. **Question:** How does **high temperature** affect a PRV's set pressure?
Answer: Temperature affects the mechanical components:
a. **Thermal Expansion:** High-temperature fluid causes the valve body materials to expand.
b. **Spring Effect:** If the body expands more than the spring, the spring compression is reduced, which can **lower the actual set pressure** in service.
c. **Compensation:** A **Cold Differential Test Pressure (CDTP)** must be calculated to compensate for this effect.

20. **Question:** What is the significance of the ASME "**UV**" code stamp on a PRV?
Answer: The "UV" stamp is a mark of mandatory compliance and certification:
a. It signifies that the valve's design, manufacturing, and capacity are certified under the rules of the **ASME Boiler and Pressure Vessel Code (BPVC)**, typically Section VIII (Pressure Vessels).
b. It is mandatory for valves protecting vessels built to this code.

21. **Question:** What is the consequence of selecting a PRV with an **insufficient orifice size**?
Answer: The primary consequence is a complete failure of the safety system:

a. The valve will not be able to pass the **required mass flow rate** even at the maximum allowable accumulation/overpressure.
b. This will cause the vessel pressure to continue rising above the maximum code limit, leading to **catastrophic failure** (rupture).

22. **Question:** When must **two or more PRVs** be used on a single vessel?
Answer: Multiple valves are required in two main situations:
a. **Required Capacity:** When a single available valve cannot provide the necessary **total relieving capacity** for the worst-case scenario.
b. **Staggered Set Points:** When code rules require staggering set points (e.g., one valve at MAWP, a second at a higher accumulation limit for a **fire case**).

23. **Question:** Why are liquid service relief valves designed for **gradual lift**?
Answer: The proportional lift is necessary for system stability: a. **Fluid Property:** Liquids are incompressible, so the "pop" mechanism used for vapor/gas is unnecessary. b. **Stability:** The gradual opening minimizes severe pressure shock waves, or **liquid hammer**, in the system and discharge piping that a rapid pop action would cause.

24. **Question:** What essential information is required on a PRV **nameplate**?
Answer: The nameplate must contain all data necessary for safe application and retesting:
a. Manufacturer, Model, and Serial Number.
b. Inlet and Outlet Size.
c. **Set Pressure** and **Cold Differential Test Pressure (CDTP)** (if applicable).
d. **Certified Capacity** (Flow Rate).
e. **ASME Code Stamp** (UV or V) and **Orifice Designation**.
25. **Question:** What is the purpose of the adjustable **nozzle ring** in a conventional PRV? **Answer:** The nozzle ring is primarily used to adjust the **blowdown** (the difference between the set pressure and reseating pressure) and tune the valve's lifting characteristics for stable operation.

II. Selection and Sizing (Cont.)

26. **Question:** What is the single most critical input required for PRV **sizing calculations**?
Answer: The **Required Relieving Capacity** (W in lb/hr or Q in SCFM/GPM). This value, derived from the worst-case overpressure scenario, dictates the minimum required effective discharge area (A).

27. **Question:** List three common **overpressure scenarios** used for PRV sizing. **Answer:**
    a. **Blocked Outlet:** Failure of a downstream valve, preventing flow out of the system.
    b. **External Fire Exposure:** Heat input from an external fire causing rapid vaporization.
    c. **Loss of Cooling or Utility Failure:** Loss of cooling water in an exchanger or reactor, leading to uncontrolled temperature and pressure rise.

28. **Question:** How do you calculate the required capacity for an **external fire scenario**?
    Answer: Fire sizing follows a specific methodology:
    a. **Heat Input:** Use the API 521 formula to calculate the heat absorbed (Q) by the **wetted surface area** of the vessel ($Q \propto A^{0.82}$).
    b. **Vaporization Rate:** Convert the heat input (Q) to a required mass flow rate (W) using the fluid's **latent heat of vaporization** (λ) ($W = Q/\lambda$).

29. **Question:** What information is needed to size a valve for **liquid service**?
    Answer: Sizing for liquid requires several fluid-specific properties:
    a. Required Flow Rate (GPM or m3/hr).
    b. Set Pressure and Overpressure.
    c. Specific Gravity (G) and Temperature.
    d. **Viscosity (μ)** (required for the viscosity correction factor Kv).

30. **Question:** When must **two-phase flow** be considered for sizing?
    Answer: Two-phase flow (simultaneous vapor and liquid relief) is complex and must be considered when:
    a. **Flashing Liquid:** A liquid is relieved and flashes partially into vapor due to pressure reduction across the seat.
    b. **Fire Relief:** Rapid vaporization occurs from the liquid level in the vessel due to external heat.
    c. **Chemical Reaction:** A runaway reaction produces a mixture of liquid and gas simultaneously.

31. **Question:** What is the significance of the **90% of set pressure leakage check**?
    Answer: This test pressure (API 527) confirms:
    a. The valve will maintain a tight seal and not leak or "**simmer**" at the maximum expected normal operating pressure.
    b. It minimizes product loss and protects the seating surfaces from premature **erosion**.

32. **Question:** Explain the use of a **rupture disc (RD) in combination with a PRV** (RD-PRV tandem).
    Answer: This combination enhances protection and valve life:

a. **Purpose:** The RD acts as a primary, bubble-tight seal, protecting the PRV's internal workings from continuous exposure to **corrosive or fouling fluids**.
b. **Installation:** The RD is upstream. A **tell-tale indicator** must be installed between the RD and PRV to detect disc rupture.

33. **Question:** What is the maximum **operating pressure** recommended for a **conventional PRV**?
Answer: The maximum continuous operating pressure should not exceed **90% of the set pressure**.
a. Operating higher risks valve simmering, seat erosion, and premature lifting due to pressure fluctuations.

34. **Question:** What type of trim material is often used for **steam service** and why?
Answer: Hardened stainless steel or **Stellite** seats and discs are used.
Reason: To resist **wire drawing**, which is the severe erosion caused by high-velocity leakage or simmering of wet steam.

35. **Question:** How is the **required inlet size** determined during the selection process?
Answer: The inlet size must satisfy both capacity and pressure drop requirements: a. It must be large enough to accommodate the required **orifice area**.
b. The piping must be sized to ensure the non-recoverable pressure drop is ≤3% of the set pressure, which often requires an inlet pipe larger than the valve's orifice size.

36. **Question:** What must be specified when ordering a new PRV **spring**?
Answer: The spring is the heart of the pressure control, so accuracy is paramount: a. The required **Set Pressure** and the **Service Temperature** (for CDTP correction). b. The correct **Spring Material** and manufacturer's specific **Spring Number** or part designation.

37. **Question:** What is the maximum allowable **accumulation** for a fire case according to **ASME Section VIII**?
Answer: 21% of the Maximum Allowable Working Pressure (MAWP).

38. **Question:** What is the potential hazard of using a **conventional PRV in a corrosive service**?
Answer: The primary hazard is a **fail-to-open** condition: Corrosive fluids leaking past the seat can enter the bonnet, leading to **corrosion and seizing** of the spring, stem, and guide components.

39. **Question:** What is the critical factor to consider when sizing a PRV for a gas running near its **critical pressure**?
    Answer: The **Compressibility Factor (Z)** must be accurately determined at relieving conditions to account for the non-ideal gas behavior, which significantly impacts density and flow capacity calculations.

40. **Question:** Why is the **orifice designation** (e.g., J, K, L) important?
    Answer: The orifice designation corresponds to a specific, standardized, and **certified minimum effective discharge area (A)**. This standard is crucial for selection as it ensures the valve has the necessary flow capacity verified by the manufacturer.

41. **Question:** What are the major contributing factors to PRV **chattering**?
    Answer: Chattering is a major operational instability caused by dynamic forces:
    a. Excessive **inlet pressure drop** (>3% of set pressure).
    b. Long or restrictive **discharge piping** causing high built-up back pressure.
    c. Improper **blowdown setting**.

42. **Question:** What is the "**worst-case scenario**" principle in PRV sizing?
    Answer: The PRV must be sized to handle the **single most severe, credible overpressure event** that results in the highest required relieving capacity. Only mutually independent and credible events are considered simultaneously.

43. **Question:** How does the fluid's **critical pressure** affect vapor sizing?
    Answer: It determines whether the flow is **choked** (sonic) or **non-choked** (subsonic). The ratio of back pressure to relieving pressure dictates the flow regime, which is a key input into the API sizing formulas.

44. **Question:** Why must the **set pressure** of a PRV protecting a **heat exchanger** be considered carefully?
    Answer: The PRV set pressure must be less than the **MAWP of the low-pressure side** of the exchanger. In the event of a tube rupture, the PRV must be set to protect the weaker (low-pressure) side from catastrophic failure.

45. **Question:** When should **thermal relief valves** be used on isolated liquid piping?

Answer: They are necessary to protect the isolated section of pipe from excessive pressure buildup caused solely by **thermal expansion** of the trapped liquid due to ambient or solar heat gain.

46. **Question:** What is the advantage of a **soft-seated PRV** over a metal-seated PRV?
    Answer: Soft-seated PRVs offer **bubble-tight closure** (zero leakage) at pressures closer to the set point. This is crucial for:
    a. Expensive, light-weight, or hazardous gas services.
    b. Applications where minimizing product loss or emission is critical.

47. **Question:** What is the potential sizing challenge when relieving a **sub-cooled liquid**?
    Answer: Even if the liquid is sub-cooled, if the pressure drops significantly across the valve seat, the liquid may partially **flash** (vaporize). This creates two-phase flow conditions, requiring a more complex (and often larger) sizing calculation.

48. **Question:** What is the recommended **blowdown** for a conventional PRV in vapor/gas service?
    Answer: Typically between **3% and 7%** of the set pressure, as per manufacturer and code guidelines, to ensure stable operation and positive reseating.

49. **Question:** What defines a **high-lift or full-lift PRV**?
    Answer: These are valves designed for the disc to lift a significant distance (up to 1/4 of the nozzle bore diameter) to fully expose the flow area, providing the **maximum certified capacity**.

50. **Question:** What is the required **overpressure** for a liquid service valve to achieve full rated capacity?
    Answer: Typically **10% overpressure** is required for full-rated liquid capacity, unless otherwise specified by the design code or manufacturer.

III. Installation Guidelines

51. **Question:** What is the mandatory **mounting orientation** for a PRV?
    Answer: The PRV must be installed **vertically** and upright with the spindle axis perpendicular to the earth's surface. Incorrect orientation can cause component **binding**, poor drainage, and affect spring alignment.

52. **Question:** What are the code requirements for **block valves** on the PRV inlet line? **Answer:** Isolation valves are strictly controlled by API and ASME:

a. **Generally Prohibited:** They are forbidden to ensure constant protection.
b. **Exception:** If required, they must be either: 1) Used with a coded **three-way diversion valve**, or 2) **Locked or car-sealed open** with strict administrative controls.

53. **Question:** What is the purpose of a **drip pan elbow** on the discharge line?
Answer: Used on valves discharging to atmosphere, it:
a. Prevents **rainwater or debris** from entering the valve outlet when the valve is closed.
b. Allows **condensate** to drain safely away from the discharge area.

54. **Question:** What is the key structural requirement for PRV **discharge piping**?
Answer: The entire discharge piping system must be **independently supported and anchored**. a. **Reason:** It must be able to withstand the substantial **thrust forces** generated when the valve opens without transferring stress to the valve body.

55. **Question:** Where should the pressure gauge connection be located for an **inlet line check**?
Answer: The gauge connection must be located as close as practically possible to the vessel nozzle connection, **upstream** of the PRV inlet.
Purpose: To accurately measure the inlet pressure drop across the piping and verify the ≤3% rule.

56. **Question:** What are the two major rules for the **diameter of the PRV inlet piping**?
Answer:
a. The inlet piping should **never be smaller** in diameter than the PRV inlet flange size.
b. It must be sized to keep the non-recoverable **pressure drop ≤3%** of the set pressure.

57. **Question:** How does **thermal expansion** affect PRV installation?
Answer: Uncompensated thermal expansion in connected piping can impose high flange stress on the valve body. This stress can cause the valve body to **distort**, leading to internal misalignment, poor seat sealing, and premature leakage.

58. **Question:** What must be done with the **vent line** on a balanced bellows PRV?
Answer: The vent line must be kept **open and unrestricted** to the atmosphere or a safe, low-pressure location. a. **Warning:** It must **never be plugged**, as this will trap pressure if the bellows ruptures, negating the balancing function.

59. **Question:** What is the requirement for PRV discharge piping when venting to a **flare header**?
Answer: The piping must be sized to manage pressure:

a. It must ensure the total back pressure (**superimposed + built-up**) remains below the valve's operating limit.
b. Proper **drainage** must be included to prevent liquid slugs from entering the header.

60. **Question:** Why should the PRV inlet line be **short and direct** with minimal elbows?
Answer: To minimize the **turbulence** and **pressure losses** caused by elbows and long runs. This is critical for ensuring compliance with the 3% inlet pressure drop rule and preventing chatter.

61. **Question:** What must be installed between an **RD and a PRV** in a tandem system?
Answer: A **pressure gauge or tell-tale indicator** (e.g., a low-pressure switch/alarm).
Purpose: To monitor for pressure accumulation caused by premature rupture or leakage of the disc.

62. **Question:** What precautions are needed for a PRV in **freezing service**?
Answer: The valve and connected piping must be protected: a. The valve body, especially the drain holes and vent lines, should be **heat traced and insulated** to prevent liquid accumulation and freezing, which can obstruct operation.

63. **Question:** What is the danger of using **excessive sealant** on threaded PRVs?
Answer: Excess sealant or pipe dope can migrate into the internal workings: The sealant can be forced into the PRV's internal moving parts (guide/disc area), causing **fouling, sticking, and seizing** (a fail-to-open condition).

64. **Question:** Can a **conventional PRV** be used on **toxic service discharging to atmosphere**?
Answer: No. a. If the fluid is toxic, the PRV must be an **enclosed design** (balanced bellows or closed bonnet) and the discharge must be routed to a flare, scrubber, or closed vent system.

65. **Question:** What is the proper procedure for tightening **flanged PRV connections**?
Answer: Flange bolts must be tightened with care to prevent distortion:
a. Bolts must be drawn down evenly in a **crisscross (star) pattern**.
b. A calibrated torque wrench must be used to ensure the torque is applied to the **manufacturer's specified value**.

IV. Testing and Inspection

66. **Question:** What is the primary objective of "**Bench Testing**" or "**Shop Overhaul**"?
    Answer: The objective is to requalify the safety function of the valve: To verify that the PRV's **Set Pressure** and **Seat Tightness** meet the required specifications following disassembly, repair, and reassembly.

67. **Question:** What is the significance of the **API 527 standard** in PRV testing?
    Answer: API 527 (Seat Tightness of Pressure Relief Valves) is the industry benchmark for leak testing: a. It specifies the mandatory test procedure and the acceptable **leakage rates** (in bubbles per minute) for metal-seated PRVs when tested at 90% of the set pressure.

68. **Question:** Define and explain the purpose of "**In-Situ Testing**" (Trevitest).
    Answer:
    a. **Definition:** Testing the PRV's set pressure while the valve remains **installed on the vessel**, using an external lifting device.
    b. **Purpose:** To verify the set point under actual operating conditions (**temperature, superimposed back pressure**) without requiring system shutdown.

69. **Question:** What must be checked during a visual "**As-Found**" inspection of a PRV removed from service?
    Answer: The inspection confirms the valve's condition prior to service:
    a. Check the integrity of the **set pressure seal** (tamper-evident wire/lead seal).
    b. Look for external signs of **leakage** and body **corrosion**.
    c. Check for bent levers or external structural damage.

70. **Question:** What is a "**VR**" stamp, and who issues it?
    Answer: The **VR (Valve Repair)** stamp is issued by the **National Board (NB)**. It certifies that the facility is an **Authorized Repair Organization (ARO)** qualified to service, reassemble, and test PRVs according to NBIC standards.

71. **Question:** When performing a **shell (hydrostatic) test**, what pressure is typically applied?
    Answer: The valve body and bonnet are typically hydrostatically tested to **1.5 times the valve's design pressure** or MAWP.
    Purpose: To verify the structural integrity of the pressure-containing parts (casting, flanges, and welds).

72. **Question:** What is the required leakage rate for a **soft-seated PRV** after repair/testing?
    Answer: Soft-seated valves (using PTFE, elastomers, etc.) are generally required to exhibit **zero leakage** (bubble-tight) when tested at 90% of the set pressure.

73. **Question:** What are the common **test media** used for PRV testing?
    Answer:
    a. **Air/Nitrogen:** For testing set pressure and seat tightness in gas/vapor service.
    b. **Water/Oil:** For testing set pressure in liquid service (hydrostatic).
    c. **Steam:** For testing valves in high-temperature or boiler (ASME Section I) service.
74. **Question:** What is the maximum pressure a technician should apply to the **lifting lever** during testing?
    Answer: The manual lifting lever should only be actuated when the system pressure is at least **75% of the set pressure**.
    Warning: Using the lever at lower pressure requires excessive manual force, risking damage to the seating surfaces.

75. **Question:** Why must **pressure gauges** used for testing be **calibrated** and accurate?
    Answer: The integrity of the safety system depends on the gauge's reading:
    a. Gauges must be recently calibrated to a traceable standard.
    b. The gauge's range should be such that the **set pressure falls within the middle third** of the scale for optimal readability and accuracy.

V. Maintenance and Troubleshooting

76. **Question:** List three common causes of PRV "**simmering**" or continuous leakage.
    Answer:
    a. **High Operating Pressure:** System pressure is too close to the set point (≥90%).
    b. **Damaged Seating Surfaces:** Corrosion, erosion (**wire drawing**), or foreign object contamination.
    c. **Misalignment/Distortion:** Distortion from thermal stress or improper torquing.

77. **Question:** What is the **recommended interval** for PRV inspection and testing?
    Answer: Intervals are service-dependent (API 576 provides guidance):
    a. **Corrosive/Fouling Service:** Shortest interval (e.g., **1 year**).
    b. **Clean/Non-Fouling Service (Air/Steam):** Longer interval (e.g., **3-5 years**).

c. **Guidance:** The user must establish an appropriate interval based on historical performance and service conditions.

78. **Question:** How is "**wire drawing**" damage caused and how is it repaired?
Answer:
a. **Cause:** Caused by high-velocity leakage of steam or gas that **erodes a groove** into the seating surfaces.
b. **Repair:** Requires the affected parts (disc and nozzle) to be removed and precisely **re-lapped** (resurfaced) to an optically flat finish.

79. **Question:** What must be done to the **seating surfaces** during a repair overhaul?
Answer: The seating surfaces of the nozzle and disc must be:
a. Inspected for damage (pitting, scoring, wire drawing).
b. Precision **lapped** (ground) to remove imperfections and achieve a high-quality, flat finish suitable for a leak-tight seal.

80. **Question:** If a PRV **fails to reseat**, what is the most likely mechanical cause?
Answer: The inability to reseat is often due to friction or obstruction:
a. **Seizing:** The disc guide or stem is **binding** due to corrosion, fouling, or misalignment, preventing the spring force from fully seating the disc.
b. **Obstruction:** Foreign material is lodged between the disc and nozzle.

81. **Question:** How should spare PRV **springs** be stored?
Answer: Spare springs must be stored carefully to preserve their calibrated properties:
a. Stored in a **clean, dry environment** at a controlled temperature.
b. They must **not be stored under compression** or excessive stress.

82. **Question:** What is the hazard of painting or coating the PRV **nameplate**?
Answer: Painting the nameplate makes the critical, certified data (**Set Pressure, Capacity, Orifice**) unreadable, which violates code requirements and creates a serious safety risk for future testing and replacement.

83. **Question:** If fluid is leaking from the **bonnet vent** of a balanced bellows valve, what is the diagnosis?
Answer: The diagnosis is a **ruptured or leaking bellows**. a. **Action:** The valve must be removed immediately because the bellows is no longer isolating the spring chamber, the **set pressure is compromised**, and the spring is now exposed to the process fluid.

84. **Question:** What is "**galling**" in PRV maintenance, and how is it prevented?
    Answer:
    a. **Galling:** A severe form of wear caused by the adhesion of two sliding metal surfaces (e.g., stem and guide).
    b. **Prevention:** Use of **dissimilar, hard materials** (e.g., nitrided steel or Stellite) for the moving parts.
85. **Question:** Why should a PRV that has **fully lifted** be overhauled, even if it appears to reseat correctly?
    Answer: An overhaul is necessary to confirm structural integrity:
    a. A full lift subjects the valve to high impact and thermal shock, potentially causing internal damage.
    b. An overhaul verifies the integrity of the seating surfaces and requires the replacement of **all soft goods** (gaskets/O-rings) to ensure future tightness.

86. **Question:** What is the purpose of the **bonnet drain hole** on a conventional PRV in wet service?
    Answer: The drain hole ensures that any moisture (rain or condensation) that enters the bonnet assembly is allowed to drain freely, preventing **internal corrosion** of the spring and guide mechanism.

87. **Question:** What is the most important **document** to maintain for PRV history?
    Answer: The **Repair Report/Certification Sheet (VR Form)**. This document details the As-Found and As-Left test results, the parts replaced, and the final certified set pressure, serving as the official safety record.

88. **Question:** Why must the use of a PRV for **process control (bypassing)** be strictly avoided?
    Answer: PRVs are designed for **intermittent, emergency use**. Continuous service will cause rapid seat erosion ("wire drawing"), leading to continuous leakage and rendering the valve unreliable for its primary safety function.

89. **Question:** What steps are necessary if a PRV **fails its seat tightness test** during a shop overhaul?
    Answer:
    a. **Rework:** The valve must be re-disassembled, the seating surfaces **re-lapped**.
    b. **Replace:** All soft goods must be replaced.
    c. **Retest:** The complete set pressure and seat tightness tests must be **repeated and documented** until a passing result is achieved.

90. **Question:** How does **vibration** affect the longevity and performance of a PRV?
    Answer: Vibration reduces reliability: a. Excessive vibration can cause the disc to rapidly oscillate ("flutter") on the seat, leading to continuous wear, damage to the seat surfaces, and potential leakage (**simmering**).

91. **Question:** What is the potential danger of installing a "**gag**" (lifting stop) on a PRV and forgetting to remove it?
    Answer: A lifting gag or shipping stop **prevents the valve from lifting**. If not removed, the valve is completely disabled, and the vessel is left unprotected from overpressure, guaranteeing a dangerous failure.

92. **Question:** What is the rule for PRV inspection after a major **plant turnaround or modification**?
    Answer: Any PRV affected by a major modification (piping change, set pressure change) or located on equipment in a major turnaround must be:
    a. Visually inspected for external integrity.
    b. Often, the **set pressure must be verified** before re-commissioning the system.

93. **Question:** How does **erosion** differ from **corrosion** in a PRV?
    Answer:
    a. **Corrosion: Chemical** material degradation caused by reaction with the process fluid.
    b. **Erosion: Mechanical** material removal caused by the high-velocity movement of fluid (especially if dirty or wet) over the internal surfaces.

94. **Question:** What should be documented regarding the **torque** on bonnet bolts during reassembly?
    Answer: All bonnet bolts must be tightened to the manufacturer's **specified torque sequence and value** using a calibrated torque wrench.
    Purpose: This ensures the uniform seating of the body/bonnet gasket and prevents body **distortion**, which could cause seat misalignment.

95. **Question:** When troubleshooting chatter, why is the **discharge line** often checked first?
    Answer: The discharge line is checked for excessive back pressure: High built-up back pressure due to restriction or clogging can cause the pressure to rapidly build up after the initial pop, reducing the pressure differential and forcing the valve to **reseat prematurely**, contributing to chatter.

96. **Question:** What is the **Cold Differential Test Pressure (CDTP)**, and how is it used? **Answer:**

a. **Definition:** The set pressure adjusted to compensate for the **reduction in spring force** when the valve operates at an elevated service temperature.
b. **Use:** It is the pressure at which the valve is bench-tested **while cold** to ensure it will open at the correct, higher set pressure when hot.

97. **Question:** What is the consequence of **not replacing the soft goods** (gaskets, O-rings) during an overhaul?
Answer: The soft goods are subject to compression set and chemical degradation. Reusing them significantly increases the risk of both **external leakage** (environmental hazard) and **internal leakage** (compromising set pressure stability).

98. **Question:** How does the use of a flow diffuser or **silencer** affect discharge sizing?
Answer: A flow diffuser/silencer can introduce a significant **pressure drop (back pressure)** into the discharge line. The sizing of the discharge piping system must account for this added resistance to ensure the total back pressure remains within the valve's operating limits.

99. **Question:** What information is needed to replace a PRV with an **exact equivalent**?
Answer: All certified nameplate data is required:
a. Manufacturer, Model, and Serial Number.
b. Inlet/Outlet Size, **Set Pressure**, and **Orifice Designation**.
c. **Spring Number/Range** (to ensure the correct spring is used).

100. **Question:** Summarize the "**Golden Rule**" of PRV safety and integrity.
Answer: "The PRV must be capable of opening at the certified set pressure and discharging the required capacity under all conditions to protect the equipment, and it must reclose and remain tight afterwards."