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1.0 SCOPE

1.1 This Basic Practice covers mandatory requirements governing the design, inspection and testing of pressure relief valves.

1.2 Any deviation from this Practice must be approved by the procedure described in RP 0-1-3 .

1.3 An asterisk (*) indicates that a decision by the Owner's Engineer or Owner is required, or that additional information is furnished by the purchaser.

1.4 A revision bar indicates all changes made to this Revision.

2.0 REFERENCES

The latest edition of the following standards and publications are referred to herein, and shall be used with this Practice.

STANDARDS AND PUBLICATIONS

BP Oil Refining Practices

RP 0-1-3	Deviations to BP Oil Refining Practices
RP 5-2-1	Selection of Piping Components and Materials
RP 5-2-2	Flanges, Gaskets and Bolting
RP 5-3-1	Valve Design and Selection Criteria
RP 5-3-14 DS	Pressure Relief Valves Data Sheet
RP 5-3-16	Supplemental Requirements for Valves
RP 6-1-1	Pressure Relieving Systems
RP 13-2-1	Material Requirements for Aggressive Environmental Services
RP 13-3-1	Supplemental Requirements for Metallic Materials
RP 13-4-1	Material Hardness Requirements

ASME Codes

Sec I	Power Boilers
Sec VIII	Pressure Vessels, Division 1
Sec VIII	Pressure Vessels, Alternative Rules, Division 2
B31.3	Chemical Plant and Petroleum Refining Piping

NACE Standard

MR-01-75	Sulfide Stress Corrosion Cracking Resistant Metallic Material for Oil Field Equipment

STANDARDS AND PUBLICATIONS (CONTINUED)

ASME/ANSI Standards

B 1.20.1	Pipe Threads, General Purpose (Inch)
B16.5	Steel Pipe Flanges and Flanged Fittings
B16.34	Valves – Flanged, Threaded and Welding End

API Publications

Std 526	Flanged Steel Pressure Relief Valves
Std 527	Seat Tightness of Pressure Relief Valves
Publ 941	Petroleum Refineries and Petrochemical Plants

3.0 DEFINITIONS

3.1 Accumulation – The pressure increase over the maximum allowable working pressure of a vessel during discharge through the pressure relief valve. Expressed as a percentage of the maximum allowable working pressure or in pounds per square inch.

3.2 Aggressive Environmental Service (AES) – Process services which result in material degradation such as cracking, scaling, blistering, and severe pitting and/or corrosion. Examples of such services are hydrogen service, wet hydrogen sulfide, cyanides, caustic, amine, and hydrofluoric acid. AES process fluids are defined in RP 13-2-1 .

3.3 Back Pressure – The pressure that exists at the outlet of the pressure relieving device because of pressure in the discharge system (see also “Built-up back pressure” and “Superimposed back pressure).

3.4 Balanced Safety Relief Valve – A safety relief valve that incorporates means, such as a pressure balancing bellows or piston, for minimizing the effect of back pressure on the performance characteristics, such as, opening pressure, closing pressure, lift, and relieving capacity.

3.5 Built-up Back Pressure – The pressure in the discharge header that develops as a result of flow after the pressure relief valve opens.

3.6 Contractor – Company or business that agrees to furnish materials or perform specified services at a specified price and/or rate to the Owner.

3.7 Conventional Pressure Relief Valve – A closed-bonnet Pressure Relief valve whose bonnet is usually vented to the discharge side of the valve.

3.8 Free Machining Steels – Those which contain any of the following elements in the quantities shown:

1. Greater than 0.06% phosphorous
2. Greater than 0.06% sulfur
3. Intentional lead additions in excess of 0.05%
4. Intentional selenium additions in excess of 0.05%

3.9 Hydrogen Rich Service – A service defined as a combination of hydrogen partial pressure and temperature at or below the curve for carbon steel per Figure 1 of API Publication 941, latest edition, and with a hydrogen partial pressure greater than 100 psia.

3.10 Hydrogen Service – A service defined as a combination of hydrogen partial pressure and temperature above the curve for carbon steel per Figure 1 of API Publication 941, latest edition.

3.11 Inspector – A BP Oil Company appointed engineer or inspector.

3.12 Lift – The actual travel of the disk away from the closed position when the valve is relieving.

3.13 Manufacturer – The recipient of a direct or indirect purchase order for materials and/or equipment. In this context, a direct order is one issued to a manufacturer by a contractor or the Owner. An indirect order is one issued to a manufacturer by a vendor (recipient of a direct order) for materials, fabricated components, or subassemblies.

3.14 Maximum Allowable Working Pressure – Measured in pounds per square inch gauge, is the maximum gauge pressure permissible at the top of a completed vessel in its operating position for a designated temperature. The design pressure may be used in place of the maximum allowable working pressure in cases in which calculations are not made to determine the value of the latter.

3.15 Open-Bonnet Pressure Relief Valve – A pressure relief valve whose spring is directly exposed to the atmosphere through the bonnet or yoke.

3.16 Operating Pressure – The pressure, measured in pounds per square inch gauge, to which the vessel is usually subjected in service.

3.17 Overpressure – Measured in pounds per square inch gauge, is the pressure increase over the set pressure of the primary pressure relieving device. Overpressure is termed accumulation when the pressure relieving device is set at the vessel's maximum allowable working pressure.

NOTE: When the set pressure of the first (primary) pressure relief valve to open is less than the vessel's maximum allowable working pressure, the overpressure may be greater than the set pressure per the ASME Code, Section VIII, Division 1, paragraph UG–25.

3.18 Owner – BP Company.

3.19 Owner's Engineer – A BP Company appointed engineer.

3.20 Pilot Operated Pressure Relief Valve – A valve that has the major flow device combined with and controlled by a self-actuated auxiliary pressure relief valve.

3.21 Pressure Relief Valves – A generic term applied to relief valves, safety valves and safety relief valves.

3.22 Purchaser – The party placing a direct purchase order. The purchaser is the Owner's designated representative.

3.23 Relief Valve – An automatic pressure-relieving device actuated by the static pressure upstream of the valve, which opens in proportion to the increase in pressure over the opening pressure (typically used primarily for liquid service).

3.24 Safety Relief Valve – Normally used in gas and vapor service or in liquid service, is an automatic pressure relief device suitable for use as either a safety or a relief valve, depending on the application.

3.25 Safety Valve – Normally used in gas and vapor service or in steam and air service, is an automatic pressure relieving device actuated by the static pressure upstream of the valve and characterized by rapid full opening or pop action.

3.26 Set Pressure – Measured in pounds per square inch gauge, is the inlet pressure at which the pressure relief device is adjusted to open under service conditions. In a safety or safety relief valve in gas, vapor, or steam service, the set pressure is the inlet pressure at which the valve pops under service conditions. In a relief or safety relief valve in liquid service, the set pressure is the inlet pressure at which the valve starts to discharge under service conditions. For temperature service, the "cold set" test bench pressure is a corrected pressure that has an incremental pressure added to the service "set pressure".

3.27 Superimposed Back Pressure – The static pressure that exists at the outlet of a pressure relief device at the time the device is required to operate.

4.0 MATERIALS

*__4.1__ Valve material selection including body and all other components shall be in accordance with: RP 5-3-1 ; API 526; ASME Code Section VIII, Division 1 or Division 2; and the additional requirements of this Practice.

*__4.2__ Unless otherwise specified by the Owner's Engineer, requirements for valve materials shall be in accordance with Table 1.

4.3 The body to bonnet flange joint gasket shall be in accordance with RP 5-2-2 . All body flanges shall be designed for through bolting.

4.4 All internal gasket materials shall be asbestos free.

*4.5 The bonnet bolting material will be specified by the Owner's Engineer, and shall be of the same material specification as the bolting used for the connecting piping, refer to RP 5-2-1 .

*4.6 The bonnet bolting material for austenitic stainless steel and nickel alloy valves (body and bonnet) shall be strain hardened; and of the same nominal chemistry as the body unless otherwise specified for through-bolted bonnet flanges.

4.7 The chemical composition of cast or forged valve bodies with socket weld ends shall be restricted in accordance with the requirements of RP 13-3-1 .

*4.8 All nonmetallic materials used in the valve shall be capable of withstanding the maximum temperature encountered in service and during steamout. Service limits for soft-seat materials shall be in accordance with RP 5-3-1 , or the Manufacturer's Standard if approved by the Owner's Engineer.

4.9 Valves for use in sour gas (H_2S) service shall use materials which conform to NACE MR0175, except that hardness requirements for the body, bonnet, and stem shall be per RP 13-4-1 . In addition, free machining steels as defined in this Practice shall not be used in sour gas service.

5.0 DESIGN AND FABRICATION

5.1 Pressure relief valves protecting unfired pressure vessels and piping shall be constructed in accordance with the ASME Code Section VIII, Division I or Division 2 and API 526. Pressure relief valves protecting steam generation equipment that is constructed in accordance with the ASME Code Section I shall conform to the requirements of this code. All pressure relief valves shall be stamped per the applicable code.

5.2 Valve connections shall be in accordance with the following:

1. Flanged ends: per RP 5-2-2 . End flanges shall be integrally cast or forged with the valve body, or attached by welding.

    a. Slip-on flanges may be used for valves conforming to the ASME Code, Section VIII, within the limitations of RP 5-2-2 . In addition, slip-on flanges shall be welded on both sides, and the attachment fillet welds shall be 100% liquid penetrant examined per Appendix 8 of the ASME Code, Section VIII, Division 1.
    b. Weld-neck flanges shall be attached with full penetration welds, and 100% radiographed per the ASME Code, Section VIII, Division 1 or 2, as applicable.

2. Threaded ends: per ASME/ANSI B16.34.

5.3 Center-to-face dimensions of all flanged spring loaded pressure safety valves with D through T orifices shall be in accordance with API 526.

5.4 All valves, except thermal relief valves, shall be spring loaded, high lift, high capacity type with a top guided disc.

*5.5 Valves in steam, hot water with a temperature over 140°F, and air service shall be provided with lift levers or field test connections, in accordance with the ASME Code Section VIII, Division 1, paragraph UG-136 (a) (3). Packed lifting levers and closed bonnets shall be provided for all valves in hot water service, for services where tightness on the discharge side is necessary and where conditions are such that periodic testing is required. For other steam or air services, open bonnets with open lifting levers are acceptable when approved by the Owner's Engineer. Requirements for lifting levers will be specified by the Owner's Engineer.

5.6 Valves shall be furnished with springs supplied and adjusted to relieve at the initial relieving pressure, at the specified initial back pressure, and the operating temperature.

*5.7 Marking of springs 0.125 inch wire diameter and larger shall be with symbols which will identify the manufacturer, pressure-temperature range, material and size. For springs less than 0.125 inch wire diameter, the designation shall be shown on a metal tag. If approved by the Owner's Engineer, the Manufacturer may propose and use an alternative system for spring marking.

*5.8 Unless otherwise specified by the Owner's Engineer, all flanged spring loaded pressure relief valves shall have full nozzles arranged so that the nozzle and the parts comprising the disc are the only parts exposed to inlet pressure or to the corrosive action of the fluid when the valve is closed.

5.9 All valves, except as allowed in paragraph 5.5, shall be provided with pressure-tight bonnets, except balanced bellows-type valves shall have standard threaded vent opening.

5.10 Heat treatment of the valve, if required, shall be done after completion of all welding and before final machining of seating surfaces.

5.11 All PSV's shall have a stainless steel tag in accordance with ASME Section VIII Div. 1 or the applicable code. As a minimum the PSV number, set point, and ate of test shall be marked on tag.

6.0 INSPECTION AND TESTING

6.1 Pressure relief valves shall be tested and certified by the Manufacturer in accordance with the requirements of ASME Section I or ASME Section VIII, Division 1 or 2, as applicable, and the additional requirements of this Practice.

6.2 Pressure testing of pressure relief valves shall be as follows:

1. A valve inlet hydrostatic test shall be performed at 1.5 times the specified valve set pressure rounded off to the next higher 25 psig increment.

2. A shell pneumatic pressure test shall be preformed using air as a test media at 90 psig minimum to 100 psig maximum.

6.3 Each valve shall be tested to demonstrate its set point. Valves intended for steam service shall be tested with steam, valves intended for liquid service shall be tested with water, and valves intended for vapor or air service shall be tested with air.

6.4 The Manufacturer shall supply certification of the set pressure test showing the set pressure, date and signature of the Manufacturer's representative.

6.5 Each valve shall be tested for seat leakage with the medium used for the set pressure test. Leakage tests shall be in accordance with API 527.

6.6 Immediately after testing,the valve inlet and outlet connections shall be closed and seated to prevent the entrance of foreign matter.

7.0 VALVE DATA SHEET INSTRUCTIONS

*__7.1__ The information on the Pressure Relief Valve Data Sheet, see RP 5-3-14 DS , is to be filled out by the Purchaser prior to placement of a valve order.

7.2 The completed valve Data Sheet can be used in conjunction with this Practice and RP 5-3-16 as a valve purchase specification.

7.3 A line-by-line description of the information to be provided on the Data Sheet is provided in the following subparagraphs. Each subparagraph number refers to a line number on the Data Sheet. An asterisk (*) indicates information that is to be furnished by the Purchaser. All items without an asterisk are stipulated in either RP 5-3-1 or this Practice, or are to be completed by the Manufacturer.

*1. Fill in the item number.

*2. Fill in the user's pressure relief valve identification number.

*3. Specify service, line, or equipment on which the valve is to be mounted.

4. Fill in the name of the Manufacturer, if desired.

5. Fill in the Manufacturer's model or type numbers, if desired.

*6. Specify the number of valves required.

*7. Give description of the valve inlet (full nozzle, semi-nozzle, or other type).

*8.a. Specify whether the valve is classified as a safety, relief, or safety relief type valve.

*8.b. Specify whether the valve is conventional, balanced bellows, or pilot operated.

*9. Specify open or closed bonnet.

*10. Specify the nominal pipe size of the inlet and outlet connections.

*11. Specify the ASME/ANSI B16.5 class of flanged connections for the inlet and outlet flanges. If the valve has threaded connections, write in “threaded.”

12. Specify the flange facing for the inlet and outlet flanges.

*13. Specify whether the valve shall meet the requirements of RP 13-4-1 and NACE MR-01-75.

*14. Specify the material of the body and bonnet.

*15.a. Specify the material of the seat or the nozzle and disk.

*15.b. If a resilient soft seat seal is required, specify the material of the seal, otherwise, specify “no.”

16. Specify the material of the guide and the adjusting ring or rings.

17. Specify the material of the spring.

18. Specify the material of the bellows.

*19. If the valve is to have a cap and no lever, specify a screwed or bolted cap.

*20. If the valve is to have a lifting lever, specify whether it is plain or packed.

*21. If a test gag is required, write in “yes,” otherwise, “no.”

22. Specify other accessories that are required (for example, wire seal).

23. Specify other accessories that are required (for example, wire seal).

*24. Specify the applicable code. (ASME Section I, Section VIII, API)

*25. Write in “yes” if fire governs the selection of the valve.

*26. Specify the basis of selection if other than fire, such as cooling water failure, blocked discharge, thermal relief, or other.

*27. Indicate the flowing fluid and its state (liquid, gas, or vapor).

*28. Specify the quantity of fluid that the valve is required to relieve at the relieving conditions, and the fluid units (pounds per hour, gallons per minute, cubic feet per minute, etc.).

*29. Specify the molecular weight or specific gravity of the fluid at the flowing temperature.

*30. Specify the viscosity and the units of viscosity at the flowing temperature.

*31. Specify the operating pressure, in pounds per square inch gauge, and the set pressure, in pounds per square inch gauge.

*32. Specify the operating temperature, in degrees Fahrenheit, and the temperature at which the valve relieves, in degrees Fahrenheit.

*33. Specify the design temperature in degrees Fahrenheit, and the design pressure in pounds per square inch gauge.

*34. Specify the amount of superimposed back pressure that normally exists on the valve outlet, in pounds per square inch gauge.

*35. If the back pressure is variable, specify the range of variation, in pounds per square inch gauge.

*36. Specify the built-up back pressure that results during the relieving mode in pounds per square inch gauge.

*37. Specify the differential set pressure. For conventional valves, the differential set pressure is the set pressure less the constant back pressure. For balanced valves, the differential pressure and the set pressure are the same.

*38. Specify the overpressure allowed, as a percent.

*39. Specify the compressibility factor, if used.

*40. Give the specific heat ratio as $k_p = C_p/C_v$.

41. Specify the calculated orifice area, in square inches.

42. Specify the selected orifice area, in square inches.

43. Specify the letter designation of the selected orifice.

44. Specify additional notes, if required.

TABLE 1
MINIMUM MATERIAL REQUIREMENTS FOR PRESSURE RELIEF VALVES

Valve Component (1)	Minimum Material Requirements			
	Carbon Steel	Low Alloy	Stainless Steel	Monel (2)
Body, Bonnet, Cap	SA 216 Gr WCB or WCC	SA 217 Gr WC6	SA 351 Gr CF8M	Monel
Nozzle, Adjusting Ring, Disc Insert, Holder, Guide	AISI Type 316	AISI Type 316	AISI Type 316	Monel
Spring	Carbon Steel-Cadmium Plated (3)	Alloy Steel-Cadmium Plated	AISI Type 316	Monel
Spindle	AISI Type 410 416, 316	AISI Type 410 416, 316	AISI Type 410	Monel
Bellows and Disc Holder	AISI Type 316L, 321 or Inconel	AISI Type 316L, 321 or Inconel	AISI Type 316L, 321 or Inconel	Monel

NOTES:

*(1) Materials for components not listed shall be per the Manufacturer's Standard and subject to the approval of the Owner's Engineer.

(2) Per RP 5-2-1.

(3) Use alloy steel – Cadmium Plated for temperatures over 450°F.