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Chapter 1 : API RP Part 2 - PDF documents

API Std , Part 1 Sizing, Selection, and Installation of Pressure-relieving Devices, Part I - Sizing and Selection, Ninth Edition API RP January

The relief system may include: The relief device Flashback protection A gas outlet A scrubbing vessel should be provided for liquid separation if liquid hydrocarbons are anticipated. The relief-system outlet may be either vented or flared. If designed properly, vent or flare emergency-relief systems from pressure vessels may be combined. Some facilities include systems for depressuring pressure vessels in the event of an emergency shutdown. The depressuring-system control valves may be arranged to discharge into the vent, flare, or relief systems. The possibility of freezing and hydrate formation during high-pressure releases to the atmosphere should be considered. Design considerations There are three main engineering considerations when designing or modifying a relief system: Determining the relief requirements of individual pieces of equipment and selecting the appropriate devices to handle the imposed loads. Designing a relief header system that will handle the imposed loads or expansion modifications. Defining reasonable total relief loads for the combined relief header or disposal system and designing an appropriate disposal system with minimum adverse impact to personnel safety, plant-process system integrity, and the environment. These considerations are interrelated in such a way that makes it impossible to establish a procedural guideline that would be valid for most cases. The design of one portion of a relief system must be considered in light of its effects on the relief system. Relief device selection Determining individual relief loads There are a number of industry codes, standards, and recommended practices that provide guidance in the sizing, selection, and installation of relief devices and systems. When the worst-case relief load is caused by a control valve failing to open blocked discharge , the relief device should be sized with full-sized trim in the control valve, even if the actual valve has reduced trim. When the worst-case relief load is caused by gas blowby, the relief device should be sized with full-sized trim in the smallest valve in the liquid-outlet line, even if the actual valve has reduced trim. Many vessels are insulated for energy savings. Thermal insulation limits the heat absorption from fire exposure as long as it is intact. It is essential that effective weather protection be provided so that insulation will not be removed by high-velocity fire-hose streams. Types of pressure relief devices The two primary types of relief devices are the relief valve and rupture disk. Relief valves The three basic types of pressure-relief valves are conventional spring loaded, balanced spring loaded, and the pilot operated. In the conventional spring-loaded valve Fig. If the bonnet is vented to the atmosphere, relief-system backpressure decreases the set pressure. If the bonnet is vented internally to the outlet, relief-system backpressure increases the set pressure. The balanced spring-loaded valve incorporates a means to protect the bonnet, spring, and guide from the released fluids and minimizes the effects of backpressure. The disk area vented to the atmosphere is exactly equal to the disk area exposed to backpressure. These valves can be used in corrosive or dirty service and with variable backpressure. The pilot-operated valve is combined with and controlled by an auxiliary pressure pilot. The resistance force on the piston in the main valve is assisted by the process pressure through an orifice. The net seating force on the piston actually increases as the process pressure nears the set point. Rupture disk devices The rupture-disk device is a nonreclosing differential-pressure device actuated by inlet static pressure. The rupture disk is designed to burst at set inlet pressure. The device includes a rupture disk and a disk holder. The rupture disk may be used alone, in parallel with, or in conjunction with pressure-relief valves. They are manufactured in a variety of materials with various coatings for corrosion resistance. Relief system considerations The entire relief system must be considered before selecting the appropriate relief device. The relief headers should be designed to minimize pressure drop, thus allowing for future expansion and additional relief loads. Balanced valves and relief headers are designed as a system to operate at a higher backpressure. The balanced valve is more expensive than conventional valves; however, the total cost of the use of balanced valves plus the smaller header system may be lower. Capacity is reduced at the larger backpressure, so it may not be the solution for all backpressure problems. In the bellows model, the bellows is a flexible pressure vessel that has a maximum backpressure limit that is lower in larger valve sizes. Bellows are available in a limited number of materials and may deteriorate rapidly under certain exposure conditions. Bellows should be checked periodically for leakage. A leaking bellow does not provide backpressure compensation, and it allows the relief header to leak to the atmosphere. The balanced valve commonly is used to tie a new low-pressure-relief load into an existing heavily loaded relief header or to protect the relief-valve top works from corrosive gases in the relief header. Pilot-operated valves should be considered for all clean services within their temperature limitations. They are well suited for pressures below 15 psig and are available with the pilot-pressure sensing line connected to either the valve inlet or to a different point. Pilot-operated valves provide tight shutoff with very narrow margins between operating pressure and set pressure. Special considerations When selecting the appropriate relief devices to handle the imposed loads, several issues must be considered. The greater the margin between the set pressure and the operating pressure, the less likelihood there is of leakage. Aside from the requirements to compensate for superimposed backpressure, there is no reason to set a relief device at less than the MAWP. Backpressure The backpressure at the outlet of every relief device should be such that the device can handle its design capacity with the calculated backpressure under the design relief conditions. Dual relief valves It is common practice to install two relief valves in critical process applications where a shutdown cannot be tolerated. The intent is that if the first relief valve lifts and fails to reseat, a second relief can be switched into service before the first valve is removed for maintenance, without shutting down or jeopardizing the process. This is accomplished by piping the relief valves in parallel and by putting a "car sealed" full-port ball or gate block valve on the inlet and outlet of each relief valve. One set of block valves is sealed open and the other sealed closed. ASME-approved selector valves are available, which simplify relief-valve switching. This provides an interlock of parallel inlet and outlet block valves and ensures full protection for the process equipment. Multiple relief valves Multiple relief valves are required when the relief load exceeds the capacity of the largest available relief valve. It is good practice to install multiple relief valves for varying loads to minimize chattering on small discharges. The primary relief valve must be set at or below the MAWP. Supplemental relief valves should have staged pressures. If different-sized relief valves are used, the smallest relief valve should be set to the lowest pressure. Sizing the relief device The most difficult factors for specifying a relief device are determining the limiting cause of pressure relief, determining the relief load and properties of the discharge fluid, and selecting the proper relief device. When the loads are known, the sizing steps are straightforward. RP , Part 1, provides formulas for determining the relief-valve orifice area for vapor, liquid, and steam relief. The size of a relief valve should be checked for the following conditions. Blocked discharge One design condition for the sizing of a relief valve is to assume that it must handle the total design flow rate gas plus liquid into the component. It is possible to isolate a process component or piping segment for maintenance by blocking all inlets and outlets. On startup, all outlet valves could be left closed inadvertently. If the inlet source can be at a higher pressure than the MAWP of the process component, only a properly sized relief valve could keep the process component from rupturing as a result of overpressure. Gas blowby On tanks and low-pressure vessels normally receiving liquids from higher-pressure upstream vessels, the maximum flow rate through the relief valve often is determined by gas blowby. Under blowby conditions, both the normal liquid and gas outlets on the component being evaluated are functioning properly. However, the gas flow into the component could greatly exceed the capacity of the normal gas outlet. Gas-blowby conditions also can occur when a pressure regulator feeding a component fails in the open position, creating a higher than designed inlet flow rate of gas. Gas-blowby rate is the maximum that can flow given the pressure drop between the upstream component and the component being evaluated. In computing the maximum rate that can flow because of pressure drop, consideration should be given to the effects of control valves, chokes, and other restricted orifices in the line. A more conservative approach would be to assume that these devices have been removed or have the maximum-sized orifice that could be installed in the device. Fire or thermal expansion The pressure in process components exposed to the heat from a fire will rise as the fluid expands and the process liquid vaporizes. For tanks and large low-pressure vessels, the need to vent the liberated gas may govern the size of the vent or relief valve. On components that can be isolated from the process, it is possible for the process fluid contained in the component to be heated. This is especially true for cold relative to ambient service or when the component is heated such as a fired vessel or heat exchanger. It is also true for compressor cylinders and cooling jackets. The relief valves on such components should be sized for thermal expansion of the trapped fluids. This normally will not govern the final size selected unless no relief valve is needed for the other conditions. Installation considerations The installation of a relief device requires careful consideration of the inlet piping, pressure-sensing lines where used , and startup procedures. Either condition compromises the safety of the facility. Many relief-valve installations have block valves before and after the relief valve for in-service testing or removal; however, these block valves must be car sealed or locked open. Loss is calculated with the maximum rated flow through the relief valve. To minimize the inlet pressure drop to a relief valve, a conservative guideline is to keep the equivalent length-to-diameter ratio of the inlet piping to the relief valve at 5 or less. For pressure-drop limitations and typical piping configurations, refer to RP , Part 2. Piping diameters generally should be larger than the valve-outlet size to limit backpressure. Lift and set pressures of pilot-operated relief valves with the pilot vented to the atmosphere are not affected by backpressure; however, if the discharge pressure can exceed the inlet pressure e. The set pressure for balanced spring-loaded relief valves will not be as affected by backpressure as conventional spring-loaded relief valves are. Balanced relief valves will suffer reduced lift as backpressure increases. Reactive forces On high-pressure valves, the reactive forces during relief are substantial and external bracing may be required. Refer to the formulas in RP , Parts 1 [2] and 2 [3] for computing these forces. Tailpipe considerations Relief valves that are not connected to a closed relief system should have tailpipes to direct the relieving gases to a safe area away from personnel. Tailpipes should be supported at the bottom of the elbow.

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API Standard , Part 1 Sizing, Selection, and Installation of Pressure-relieving Fax: (+1) API members receive a 30% discount where applicable.

Chapter 3 : API Std , Part 1

6 API STANDARD , PART 1â€”SIZING AND SELECTION capacity The rated capacity of steam, air, gas or water as required by the applicable code. chatter Chattering is where the PRV opens and closes at a very high frequency (on the order of the natural frequency of the.

Chapter 4 : Relief Valve Orifice Area to API RP â€“ Neutrium

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FOREWORD API Recommended Practice , Sizing, Selection, and Installation of Pressure-Relieving Devices in Reï¬•neries, is the result of several years' work by engineers in the petroleum.

Chapter 9 : API Std , Part 1

API RP Part II2, Sixth Fifth Edition, Ballot 2 STD RP STD Guide for agreement with the definitions given in API Recommended PracticeSTDRP Part.