

BEST PRACTICES FOR VALVEGUARD: RUPTURE DISC & PRESSURE RELIEF VALVE COMBINATIONS

Rupture Discs (RD), also known as bursting discs, are commonly used in combination with pressure relief valves (PRV) to isolate PRVs from corrosive or otherwise fouling service on the process side and/or the discharge side of the PRV. This paper will discuss the various code requirements, the practical aspects for why an RD & PRV are combined, and recommended best practices for design and installation. The basis of the discussion comes from American Society of Mechanical Engineering (ASME) Section VIII Division 1, American Petroleum Institute (API) 520 Parts 1 & 2 and EN ISO 4126-3.

This paper is broken down into four sections:

1. RD & PRV Combinations installed at the inlet side of a PRV
2. RD & PRV Combinations installed at the outlet side of a PRV
3. Summary of differences in Standards
4. Frequently Asked Questions

1. RD & PRV INSTALLED AT THE INLET SIDE OF A PRV

1.1. Why?

The primary reasons for applying RDs upstream of PRVs include:

1. **Prevent plugging of PRV**
Some RD designs are less sensitive to product buildup.
2. **Prevent corrosion of PRV**
The RD is used to prevent corrosive materials from contacting the PRV internals during normal operating conditions. Exposure is limited to the duration of an overpressure situation and time to replace the RD.
3. **Avoid cost of high alloy PRV**
High alloys or exotic alloys for RD construction cost much less than a corresponding relief valve with the same alloy trim.
4. **Prevent leakage through PRV**
PRV's rely on the difference between the spring force and the hydrostatic force applied to the valve's disk/spindle. This results in a situation where the sealing force decreases as the valve approaches set point.
 - Newer high performance RD's such as Axis and Atlas will operate up to 95% of the specified burst pressure and affects a seal where a PRV alone would not.
 - In-place (In-situ) PRV set point testing via introducing pressure between the PRDs (Fike's Axis, Atlas, SRX can withstand high backpressures).

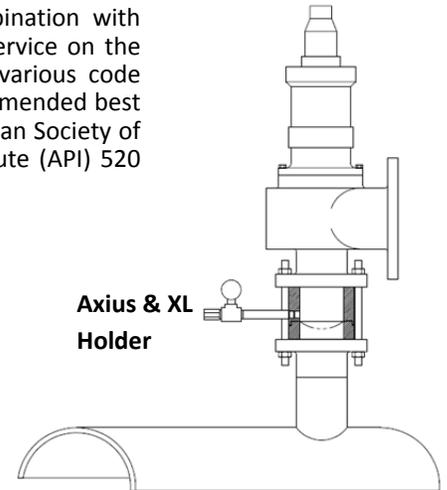


Figure 1 – Axis & XL "direct-coupled" to PRV inlet.

Note: *The RD is mounted in the same bolted flange joint as the PRV.*

1.2. How?

When installing a RD between a pressure vessel and PRV, the following requirements must be met:

1.2.1. Non-Fragmenting

The RD used on the inlet side of a PRV must be a non-fragmenting design. The RD must not eject material that can impair PRV performance. This includes relief capacity as well as the ability to reclose without leakage. Refer to section 1.2.4 for more information about single petal RD types.

1.2.2. Monitoring (tell-tale indicator)

The RD is a differential pressure device. If any back pressure accumulates between the RD and PRV, the pressure in the vessel required to burst the RD will increase in proportion. Therefore, the space between the RD and PRV must be vented and monitored to prevent/detect pressure buildup between the RD and the PRV. The ASME and EN Pressure Vessel Codes require the use of a pressure gauge, a try cock, free vent, or suitable telltale indicator.

If the space between the RD and PRV is otherwise closed, then a pressure gauge alone should not be considered suitable. This approach relies on plant personnel to periodically check each gauge to insure that pressure buildup has not occurred. This could easily result in an unsafe situation existing for hours, days or weeks at a time. A pressure switch or transmitter that provides an alarm in the control room is a more appropriate indication method. If the space between the RD and PRV is closed and does not feature a free vent, consideration should be given to using a high integrity pressure transmitter (such as Emerson Rosemount or equivalent). A pressure gauge along with a pressure switch or transmitter may be an even better choice so not only the control room is notified, but the maintenance personnel also have visibility to the elevated pressure condition prior to breaking loose the pipe flanges. This requires the holder to feature multiple gauge taps and/or piping manifolds.

In some cases, the space between the RD and PRV is not vented, but venting to atmosphere, a catch tank, or a flare/collection header may be desired. It is common in these cases to use an excess flow valve (a type of check valve) on the venting line. At very low flow conditions, as in the case of thermal expansion of trapped air, the check ball allows the fluid to vent. When the RD ruptures, the excess flow valve closes to restrict and minimize fluid loss through the vent.

No one configuration is ideal for all applications. The corrosiveness or toxicity of the media is often what drives how this space is monitored, and how the pressure and effluent vented. The RD holders available by Fike feature gauge taps for this purpose, or the tell-tale indication can be located in the downstream spacer or spool piece between the RD & PRV.

Note: *Break wire or other flow sensitive burst indication devices (Such as the Fike BC2) are not considered suitable for this function unless they are capable of detecting leakage through the RD.*

1.2.3. Capacity

The rupture disc capacity must be equal to or greater than relief area of the PRV. This generally means that the RD has to be the same nominal pipe size, or larger, than the PRV inlet. This is easily validated if the PRV and RD have been tested, and the CCCF values are listed; a summary of these are in Fike Technical Bulletin TB8103. Comparing the product of the RD minimum net flow area (MNFA) and K_d against that of the PRV orifice area and K_d provides this result. $MNFA * K_{d_{Rupture\ Disc}} \geq Orifice\ Area * K_{d_{PRV}}$. This topic will be discussed further in the section "Sizing Requirements for the RD & PRV Combination".

1.2.4. Installation

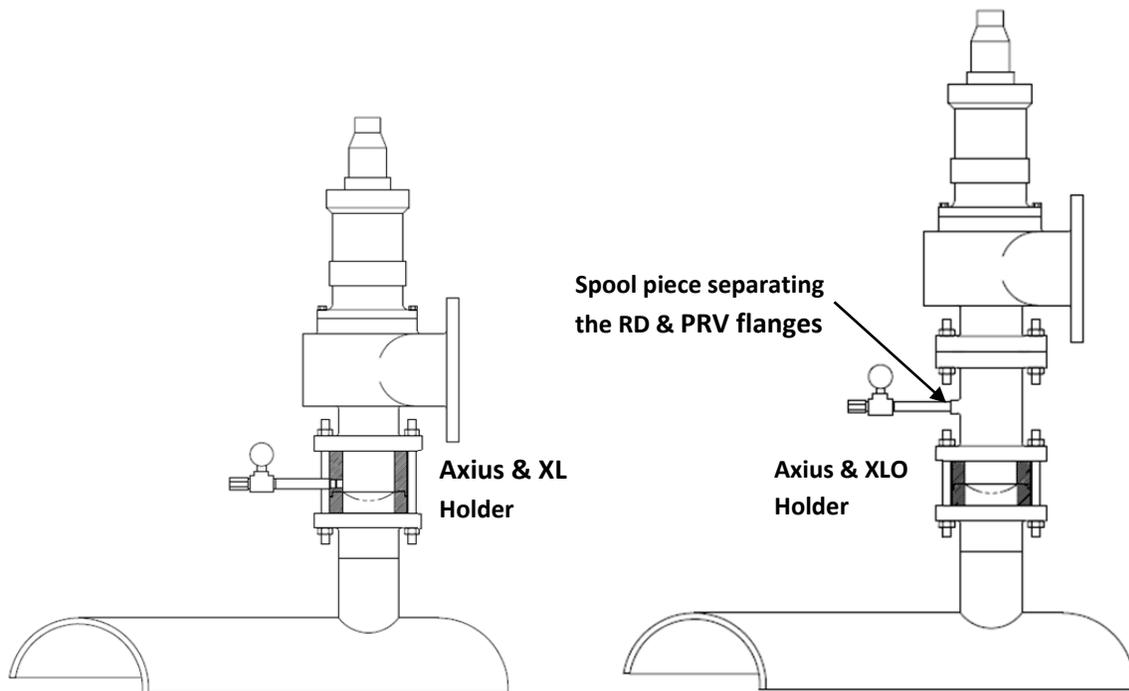
A common installation is one where the RD holder is mounted directly upstream of the PRV, in accordance with ASME. This installation is referred to as "direct-coupled" when the RD and PRV are connected in the same bolted flange joint. This is a good installation approach, but care needs to be taken to insure that the holder provides sufficient clearance to allow single petal RD designs to open without blocking the nozzle of the PRV. Single petal RDs may extend significantly beyond the outlet flange face of the holder after rupture and have the potential to block the PRV nozzle. Fike's Axius and SRL RD devices feature holder options with high-profile holders that are designed to ensure the PRV is not impaired when "direct-coupled". The Atlas-Lo holder is available with a separate spacer ring with pressure tap for the same purpose, and is installed with the holder in the same bolted flange joint as the PRV.

Often, as indicated in API 520 and ISO 4126-3, the RD holder and PRV may be separated by a piping spool piece. Short spool piece sections of 1 or 2 pipe diameters, not exceeding 5 pipe diameters (ISO 4126-3), in length are preferred. Longer pipe sections have been known to cause reflective pressure waves, from excessive line loss and valve chatter (or valve cycling), that can cause some RD petals to repeatedly bend back/forth and eventually fragment when they ordinarily would not.

There is a variety of installation practices used in industry, and the Standards are not harmonized regarding installation practices. Figure 2 illustrates the ambiguity of the term “close-coupled” by API/ISO, as both illustrations of “direct-coupled” or “spool-separated” can fall into the definition of “close-coupled”; however there are distinct and important differences. Generally, operating company practices will dictate the installation practice, and the “spool-separated” installation may be used satisfactory to ensure no petal interference with the PRV in any size or petal orientation.

Figure 2 - Direct-Coupled (left) vs. Spool-Separated (right).

Note: RD and PRV are in different flange joints with the configuration on the right. API and ISO refer to both installation practices as “close coupled”, leaving this an ambiguous term. Consideration for holder selection is influenced by the installation practice.



1.2.5. Specified BP and PRV Set Pressure

The industry provides the following guidance regarding the relationship between the specified burst pressure of the RD and the set pressure of the PRV:

- A. ASME UG-127 footnote 52 says: “...result in opening of the valve coincident with the bursting of the rupture disk.”
- B. For RD&PRV combination capacity testing, ASME UG-132(a)(4)(a) says: “The marked burst pressure shall be between 90% and 100% of the marked set pressure of the valve.”
- C. API 520 Part 1 paragraph 2.3.2.2.2 says: “...the specified burst pressure and set pressure should be the same nominal value.”
- D. EN ISO4126-3 paragraph 7.2 says: “The maximum limit of bursting pressure...shall not exceed 110% of the...set pressure or a gauge pressure of 0.1 bar, whichever is greater...”. and “ The minimum limit...should not be less than 90% of the...set pressure.”
- E. While all slightly different the basic guidance is the same and keeping the RD specified burst pressure and PRV set pressure at the same nominal value, ignoring rupture tolerances, meets the intent of each of the standards and is relatively easy to implement. This can be achieved by specifying a RD with a Zero (+/-0%) manufacturing range (ASME), or +/- Performance Tolerance (EN ISO).
- F. There may be special cases where it is desirable to have these pressures significantly different: in these cases the user should carefully evaluate both the RD and PRV function to insure that there are no adverse effects on performance.

1.2.6. Replacement after Activation or Leakage

Once the RD has burst, or when pressure is detected through the suitable tell-tale indication, corrective measures must be taken to reduce the vessel pressure immediately and replace the RD. A RD that is leaking pressure into the space between the RD & PRV can create a potentially unsafe condition if called upon to relieve, specifically due to the backpressure and rate of rise. This situation is further discussed in Fike Technical Bulletin TB8108 for Double Discs. Additionally, continual use and exposing the already burst RD to repeated relieving and blow-down conditions may cause the petals to bend and fatigue, resulting in eventual fragmentation.

1.2.7. PRV Requirements

Inlet line loss

Most pressure relief Codes and Standards address the issue of inlet line loss between the pressure vessel and the inlet of the PRV. ASME, API, and EN/ISO all limit this loss to 3% of the PRV set pressure. ASME and API evaluate this at the rated capacity of the PRV. EN/ISO requires evaluation at the maximum flowing conditions. The K_r and relief area (MNFA) values for assessing inlet line loss calculations are available in Fike Technical Bulletin TB8104.

Why is Inlet Line Loss Important?

One of the primary concerns is the concept of relief valve instability during discharge (such as discussed in API 520 Part 2 Section 7). A direct spring PRV is subject to rapid and sometimes destructive dynamic behavior under certain operating conditions. Figure 3 shows what happens as the valve goes from static (no flow) conditions to dynamic (flow) conditions. The pressure drop between the vessel and the PRV inlet causes P_v and P_i to become unequal in dynamic conditions. If P_i is less than the PRV blow down pressure (closing pressure), then a condition can develop where the PRV opens and closes very rapidly (chatter). This can cause damage to the valve seats, failure of valve components, damage to piping, and/or failure to flow at the rated capacity. This condition of reflective pressure waves during repeated relieving conditions may cause a normally non-fragmenting RD to fragment

Note: A secondary RD in parallel as a backup may be a good choice for redundancy if a primary PRV becomes unstable and cannot operate to relieve the overpressure event. Chatter may lead to the valve galling or becoming stuck in any lift position, reducing the capacity to an unknown amount.

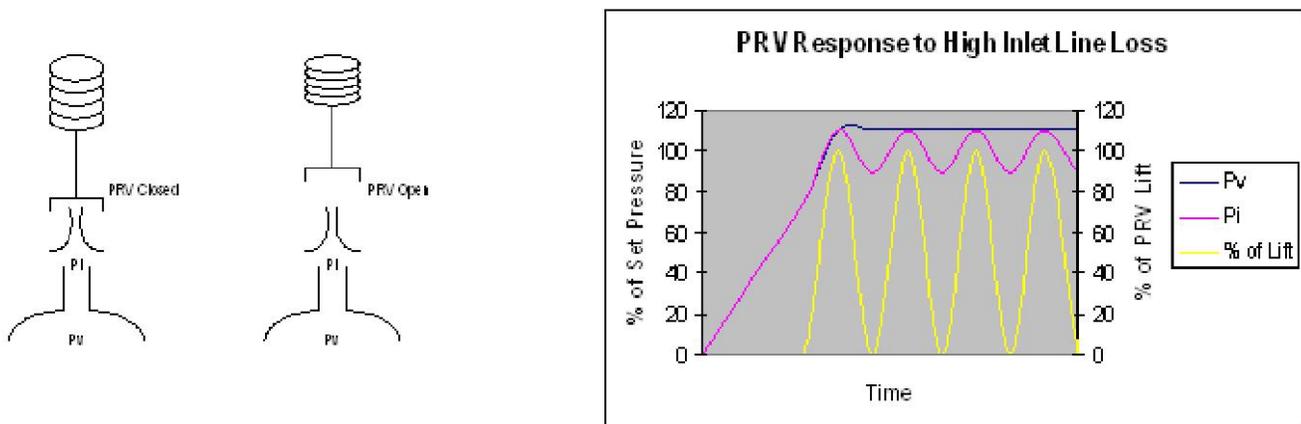


Figure 3 - Graph of Dynamics

1.2.8. Built-up Backpressure:

Conventional PRV's are generally limited to 10% built-up backpressure, and balanced bellow valves generally are acceptable up to 30 or even 50% built-up backpressures (confirm with the manufacturer). The sizing for the PRV used in combination with the RD will need to take into account the built-up backpressure for considering the valve stability. Note: Since the RD has already opened and is flowing, the built-up backpressure is not relevant to the RD performance, and is only considered for stable PRV operation and flowing capacity.

1.2.9. Sizing Requirements for the RD & PRV Combination:

The PRV sizing is completed with the applicable sizing formulas for the relieving fluid phases and Code requirement (refer to Fike Technical Bulletin TB8102 for more information on sizing equations). The RD and PRV follow the same general coefficient of discharge formulas (K_D), but the sizing process for a PRV is broken down into two steps typically according to API 520.

Step 1 - Before a specific manufacturer is selected, size using effective orifice area and effective K_D per API 526 to determine the capacity/size of the system.

Step 2 - Once a specific PRV has been selected; validate the sizing with the actual orifice area and actual K_D of the selected PRV. Next the system designer assesses the inlet line loss and built up backpressure to validate the sizing assumptions were correct.

The process of sizing for a RD & PRV combination is as it is for a standalone PRV, except a multiplier is added for the rupture disc combination (K_C). This factor is applied to the same PRV sizing formulas to de-rate the capacity of the combination. The K_C value is also known as the combination capacity factor (CCF). This factor represents the ratio of the capacity of the combination to the capacity of the valve alone. $CCF = \text{Capacity PRV \& RD} \div \text{Capacity PRV alone}$.

The default CCF (F_d for EN/ISO) for most codes is 0.9 if nothing more is known about the actual capacity. EN ISO 4126-3 adds an additional condition on the use of the default CCF. EN/ISO requires that the petal(s) of the RD be fully contained within the holder after rupture in order to use the default CCF, otherwise a tested or certified value must be used. If there is question about if the device will fully contain the petals, please contact Fike.

CCF values higher than 0.9 may be used where specific testing has been done with a particular RD&PRV combination. This is often referred to as a "certified" combination capacity factor (CCCF), and is listed in the NB-18. A summary of the Fike CCCF values are listed in Technical Bulletin TB8103. With a PRV selected and now a selected RD with a CCCF, the sizing can be assessed once more to determine the capacity of the combination.

The methods for establishing the CCCF vary based on the applicable code and are summarized as follows:

ASME Section VIII Div 1:

- Testing must be done by an authorized testing laboratory and results registered with the National Board of Boiler and Pressure Vessel Inspectors.
- Testing is performed to ASME Section VIII Div 1 part UG-132 and PTC-25. The RD is installed directly at the inlet of the PRV as indicated in figure 4.2.10-5 of PTC-25 and as required by UG-132 (a)(4)(-b).
- Testing of only one size is required to establish a CCCF for a range of sizes.
- Testing with the smallest size and minimum corresponding pressure covers all higher pressures in that size and all sizes larger.

EN ISO 4126-3:

- No certifying body or laboratory requirements.
- One size method and three size method (testing of 3 different size combinations i.e. 1", 2", 3") are accepted.
- One size method applicable to all combinations of the same size and design of RD and PRV equal to or above the tested pressure.
- Three size method applicable to all combinations of the same design of RD and PRV in all sizes equal to or greater than the smallest tested size and pressures equal to or greater than the appropriate minimum pressure for the size.

1.2.10. Nameplate Marking Requirements

Both ASME and EN/ISO have requirements for establishing nameplate marking to reflect the capacity (or combination capacity factor) of the combination, model and manufacturer of both the RD and PRV, etc. Although these are requirements of both ASME and EN/ISO this nameplate is rarely supplied because the RD and PRV are generally purchased independently with neither manufacturer aware of the other.

2. RD INSTALLED AT THE OUTLET SIDE OF A PRV

2.1. Why?

The primary reasons for applying RDs downstream of PRVs include:

1. Prevent corrosion of PRV

The RD is used to prevent corrosive vapors in common headers from contacting PRV internals during normal operating conditions.

2. Prevent variable superimposed backpressure in a common header from affecting PRV set pressure

RDs are available that have low burst pressures but can withstand higher backpressures, hence avoiding the need for PRVs equipped with balancing bellows in some cases.

3. Detect opening or leakage of PRV

Some RD types have burst indication that can signal the control room if the RD has been burst due to PRV opening or leakage.

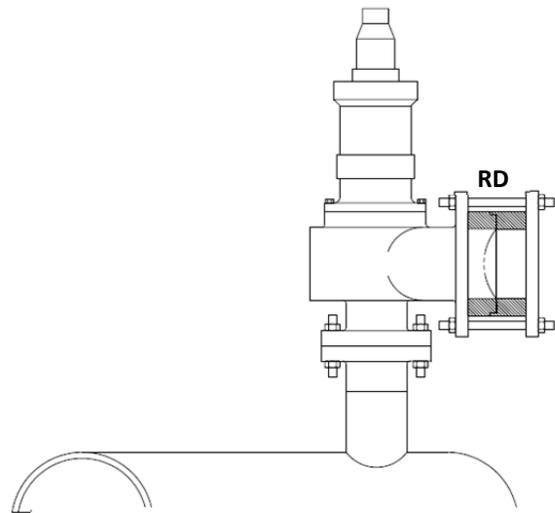


Figure 4 - RD installed at outlet flange of PRV

2.2. How?

2.2.1. RD Requirements

The marked burst pressure of the RD plus any downstream backpressure shall not exceed the design pressure of the PRV outlet or the set pressure of the PRV.

The opening through the RD device after rupture is sufficient to flow the rated capacity of the PRV without exceeding the allowable overpressure.

The system design shall consider the adverse effects of any leakage through the PRV or through the RD to ensure performance and reliability. Depending on the application's discharge, consideration should be made for selecting a RD capable of withstanding any superimposed backpressure.

2.2.2. PRV Requirements

The PRV may not fail to open at the expected opening (set) pressure regardless of any backpressure that may accumulate between the PRV and the RD. The space between the PRV and the RD shall be vented, drained or suitable means shall be provided to ensure that an accumulation of pressure does not affect the proper operation of the PRV. Venting, pressure monitoring, and selection of an RD with a low burst pressure are commonly used to meet these requirements. When a RD is installed also to the inlet of the PRV, the potential for pressure accumulation between the PRV and outlet RD is minimized as the PRV is completely isolated. Effects of thermal expansion are possible and should be considered.

The bonnet of a balanced bellows-type PRV shall be vented to prevent accumulation of pressure in the bonnet and affecting PRV set pressure.

3. SUMMARY OF DIFFERENCES IN STANDARDS

The following table compares and contrasts the various requirements within the two major standards on the subject. Note the requirements of API 520 Parts 1 & 2 are taken directly from ASME Section VIII, Division 1.

Requirement	ASME & API	EN ISO 4126-3	Comments
Definition of a RD&PRV combination	<p>A RD may be installed between a PRV and the pressure vessel... (UG127 & API 520 P2)</p> <p>The non-reclosing pressure relief device shall then be installed at the inlet of the PRV (UG132)</p> <p>When a RD device is installed at the inlet of a PRV, the devices are considered to be close coupled... (API 520 P1)</p>	<p>RD is within 5 pipe diameters of the inlet of the PRV. Referred to as close-coupled.</p>	<p>If the RD is not within 5 pipe diameters then a combination capacity factor is not applicable in the eyes of EN 4126-3.</p> <p>ASME does not use wording "close-coupled". ASME does refer to installing the RD at the inlet of the PRV, but UG127 leaves the definition loose. API refers to "close-coupled" when the RD is installed at the inlet of a PRV.</p> <p>ISO 4126-3 defines close-coupled when the RD is installed within 5 pipe diameters. Clearly, the term close-coupled is not absolute, and can refer to "direct-coupled" or "spool-separated" per figure 2.</p>
3% rule	<p>Pressure drop between the vessel and PRV inlet including the effect of the RD shall not exceed 3% of the valve set pressure at valve nameplate flowing conditions.</p> <p>API 520 provides exception to the 3% rule for pilot-operated valves or if "Engineering Analysis" is provided.</p>	<p>Pressure drop between the vessel and PRV inlet including the effect of the RD shall not exceed 3% of the set pressure of the valve at maximum flowing conditions.</p>	<p>The difference between flowing at the PRV nameplate capacity or some other maximum could be significant. i.e. what if the PRV is set well below the MAWP but sized to prevent exceeding 110% of MAWP. It may be impossible to meet the ISO requirements in this situation.</p>
Certified Combination Capacity Factor	<p>One size method applicable to all sizes equal to and larger than the tested combination.</p>	<p>One size method for a single size or three size method to be applied to a family.</p>	<p>Pursuit of the ISO 3 size combination capacity factors is cumbersome due to the cost and logistics. With a default of 0.9 the pay-back on 3 size testing is minimal.</p> <p>ASME and API provide no guidance about the use of the CCCF >0.9 if the valve is not installed directly at the inlet of the PRV, although they are developed as "direct-coupled" to PTC-25 and UG-132.</p>
Protrusion of petals into valve	<p>UG-127 requires "no chance of interference with proper functioning of the valve"</p>	<p>Petals shall not protrude into the PRV inlet unless the influence of the petals on the capacity and performance of the PRV has been assessed and proven to meet the requirements of Clause 7. (Combination Performance).</p>	<p>Both codes use language prohibiting the RD to impair the performance of the PRV. The ISO document takes a firm stand on the petal protrusion issue but points to Clause 7 which allows a default CCF (Fd) of 0.9.</p>
Documentation of the combination	<p>Nameplate marking for the combination provided by the User, PRV mfr, RD mfr, or vessel mfr.</p>	<p>Supplier of the combination shall provide the nameplate, certification, assy & installation instructions...taking into account the results of a hazards analysis.</p>	<p>In both codes there are gaps in these requirements. In practice these requirements are rarely followed.</p>

4. FREQUENTLY ASKED QUESTIONS

- Q1 Can a composite RD with a Teflon/Fluoropolymer (or other elastomer) seal or a scored RD with a Teflon/Fluoropolymer liner be used under a PRV?
- A1 When a RD with a Teflon seal or liner bursts the Teflon does break apart and discharge out of the PRV. The problem is whether you always know that it will actually discharge or get hung up stuck in the valve disk and blow down ring. There is a chance that the plastic member will hang up and then get trapped in the valve seat when it re-closes, resulting in a leak. Since re-closing is often a very important part of the PRV performance the conservative answer is no. If leak-tight re-closing is not important for the application then this type of RD may be acceptable. Although manufacturers traditionally applied composite Teflon seal RDs (such as Fike's HOV & Conventional 30° holder) with suitable spacing under PRV in the past, they are no longer recommended. Many modern RDs are available in a broad pressure and size range, with designs that prevent buildup on the holder (unlike the conventional 30° holder design). These are offered with solid metal corrosion resistance alloys that can eliminate the need for a Teflon/Fluoropolymer construction that discharges Fluoropolymer fragments upon burst.
- Q2 I am using the default combination capacity factor of 0.90 to determine the capacity of my RD&PRV combination. Do I have to also worry about the PRV inlet line loss calculation? It seems like I'm being penalized twice for using the RD.
- A2 Yes, ASME Code Interpretation VIII-1-98-43 requires that the RD be considered when calculating the inlet line loss. The RD device Kr value is used for this purpose in addition to the inlet piping components.
- Q3 How do I manage the difference in RD burst pressure and the relief valve set pressure given the manufacturing range, rupture tolerance, and set pressure tolerance?
- A3 Specify the RD and PRV at the same nominal pressure and order the RD with zero manufacturing range (ASME). The resulting differences in RD burst and PRV set pressure tolerances are insignificant and are not required to be considered when setting the burst pressure.
- Q4 The certified combination capacity factor that I want to use was based on a 1" @ 45 psig test series but my application is for a 4" @ 25 psig. Can I still use this CCCF even though it is at a lower pressure than what was tested?
- A4 No. The minimum set pressure tested during certification tests is the minimum pressure that may be used for all sizes equal to and larger than the size tested. Fike has an ASME flow test laboratory and has capabilities to perform and certify RD and PRV combinations depending on size and PRV availability. Please contact Fike if this is required.
- Q5 Where can the CCCF values for Fike RD device combinations be found?
- A5 The Kr, MNFA and CCCF certified values are listed with the National Board in the NB-18 "Redbook". The CCCF certifications are summarized on Fike Technical Bulletin TB8103, and the Kr and relief area (MNFA) values for assessing inlet line loss calculations are available in TB8104.
- Q6 The specification sheets indicate a built-up backpressure. Must I specify the RD to withstand this backpressure? Must I change the RD and PRV set pressure?
- A6 No, the built-up backpressure from the downstream valve is a flowing condition, after the RD has burst. The built-up backpressure is of importance to sizing conventional PRV's, balanced-bellows PRV's only, and this pressure may create a superimposed backpressure onto any adjacent pressure relief devices connected to the disposal system. This superimposed backpressure should be considered for the adjacent pressure relief devices, however. Constant backpressure, however, should be considered when setting the set pressure of the PRV. The RD will be isolated from a constant backpressure as the PRV is located downstream and blocks the transmission of pressure back to the RD, and any pressure that weeps through the PRV seat will be handled by the excess flow valve.
- Q7 If a pilot operated valve is fitted with a RD, where does the pilot sensing line go?
- A7 The pilot should not be installed between the RD and PRV, rather located upstream of the RD as much as possible, to maintain direct communication with the protected vessel. Pilot lines located close to or between the pressure relief devices are subject to possible turbulent flow conditions that may result in unsatisfactory lift. Additionally, remote pilot lines in direct communication with the protected vessel mitigate the line-loss concerns associated with conventional and balanced PRVs.

Q8 My application is a secondary, adjacent to another RD&PRV combination. Do I need to make any special considerations?

A8 It depends. The issue is the margin between the primary and secondary burst and set pressures relative to MAWP and Code requirements. Too narrow of a margin between the burst pressures may result in the secondary RD bursting during the primary PRV relieving plus overpressure allowance. An example is indicated below:

MAWP = 100 psig

Primary Combination (C1) = 100 psig (for both the RD and PRV)

Secondary Combination (C2) = 105 psig (set 5% above MAWP per Code for both RD and PRV)

When the primary combination begins to relieve at 100 psig, the operating ratio of the secondary RD is at 95.2% ($100 \div 105 = 95.2\%$) without even considering rupture tolerance and overpressure allowance of the primary device. When the primary device begins to relieve and accumulates to the 10% overpressure allowance permitted by Code (to achieve full lift), the pressure in the protected vessel has reached 110 psig and has burst the secondary RD, as well! Clearly, the situation is not desirable if the secondary combination is to remain sealed as a standby to deal with contingency reliefs requiring additional capacity.

One solution is to set the secondary combination (C2) equivalent to the maximum permissible by Code (generally 5% above MAWP). Then, determine the set pressure of C1 according to the following expression:

$C1 = C2 \div 110\% \text{ overpressure of C1} \times C2 \text{ Operating Ratio}\%$.

Such a solution for C1 with a Fike G2 RD rated for 95% operating ratio would be:

$C1 = 105\text{psig} \div 110\% \times 95\% = 90.6 \text{ psig}$.

Maximum operating pressure = $C1 \times C1 \text{ Operating Ratio} = 90.6 \times 95\% = 86 \text{ psig}$ for Fike G2 Technology

Setting both the primary combination RD&PRV (C1) equal to 90 psig will permit typical overpressure scenarios to be handled by the primary device without impacting the secondary combination unless the pressure continues to accumulate beyond 10%. It can be seen clearly that the operating ratio capabilities of the secondary RD and primary RD contribute to the primary RD burst pressure, and thus normal operating envelope limits for the process. Although it may appear that an effective reduction in operating pressure occurs, with ValveGuard and Fike's G2 technology, the protected vessel can now operate up to 86 psig without chance of fugitive emissions through the PRV!

Q9 When the RD has burst, can I continue to operate, since the PRV recloses?

A9 No. In addition to the points raised early, the excess flow valve (if used) is not a leak-tight device; it will continue to bleed pressure between the RD and PRV until the RD is replaced.

One of many possible alternatives is detailed in API 520 Part 2 for 100% spare relieving capacity. In such a setup, isolation (block) valves upstream and downstream of the PRD's can isolate the troubled device combination while a changeover valve places the backup PRD(combination) in service with the protected vessel for safety. The troubled PRD can then be removed/repared while the process continues with protection by the backup. Specific operations controls and procedures are described in ASME and API to ensure the protected vessel is always protected by a pressure relieving device.

- Q10: I have heard “close-coupled”, “under a PRV”, “direct-coupled” and similar to describe the application of an RD under a PRV. Are these all the same?
- A10: No, they are similar. See Figure 2. The major difference in interpretation is the distance between the RD and the PRV. “Direct-coupled” is where the RD holder outlet and PRV inlet are the same immediate bolted flange joint. “Close-coupled” does not necessarily mean it will be direct-coupled; the RD could be installed anywhere between immediately at the PRV inlet flange joint or up to 5 pipe-diameters away and still be termed “close-coupled” as indicated in ISO 4126-3. The issue of “direct-coupled” vs. “close-coupled” is important to single-petal RD devices (such as Fike’s Axius, Atlas, SRL and other single petal RD devices offered by other suppliers) where the holder height must be considered to prevent interference when the petal opens, as these have the potential to extend into the PRV nozzle under “direct-coupled” applications. The installation configuration varies according to operating company practices, so there is not a universally accepted answer. This is why Fike makes available high-profile holders or spacers, and educates the appropriate installation for safe operation. Just because a small size representative of a specific RD type was tested in accordance with ASME UG-132 and PTC-25 with a certified CCF value, does not mean all larger size devices and holder will not interfere. Users are cautioned to work closely with the supplier to ensure the installation practice has considered for their application, and made available means to ensure the design is safe and will not interfere with PRV operation if “direct-coupled”.
- Q11: Are the CCCF values listed on TB8103 performed as “direct-coupled”?
- A11: Yes, for all models. Additionally, single-petal devices (Fike’s Axius, Atlas, SRL) featured a high profile hold down on the device holder, or a suitable short spacer of equivalent overall length when the CCCF values were tested and certified. This practice is discussed in ASME Section VIII Div 1 part UG-132 (4)(-b) “The non-reclosing pressure relief device shall then be installed at the inlet of the PRV...” and per figure 4.2.10-5 in PTC-25.
- Q12: If my application is for a threaded RD device and threaded PRV, are the requirements the same?
- A12: Yes. There shall be a suitable telltale indicator installed in a threaded piping joint by design choice of the user. The RD shall be of a non-fragmenting type. Due to the relatively small sizes and piping joint for the telltale indication device, the potential for “direct-coupling” may not be practicable, so clearance is not of concern. However, not exceeding the <5 pipe diameters to ISO 4126-3 is probably the challenge. Special screw type holder executions with gauge tap ports and female threads to accept the threaded PRV are available from Fike for this purpose.

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