ASME CODE AND RUPTURE DISCS

ASME CODE CONCERNING RUPTURE DISC DEVICES

Rupture disc devices are addressed in several areas within the family of ASME Codes and Standards. The following is a listing of the most generally relevant references regarding requirements for rupture disc devices.

ASME Section VIII Division 1 UG125-UG137
ASME Section VIII Division 2 Part AR
ASME Section VIII Division 3 Part KR
ASME Section I Part PVG
ASME BPE - SD-4.1.2
ASME Section III Division 1, Subsection NB, NB-7000
ASME Section III Division 1, Subsection NC, NC-7000
ASME Section III Division 1, Subsection ND, ND-7000

Except where noted this document will address the specific requirements of ASME Section VIII, Division 1 2004 Edition 2006 Addenda (ASME Code). Many of the requirements are fundamentally the same throughout each of the sections however there are differences with regard to sizing, certification, and marking, mostly stemming from the 1998 change in Section VIII, Division 1 when UD certification and flow resistance testing were incorporated.

ASME CODE RUPTURE DISC TERMINOLOGY

- A ***rupture disc device*** is a non-reclosing pressure relief device actuated by inlet static pressure and designed to function by the bursting of a pressure containing disc.
- A ***rupture disc*** is the pressure containing and pressure sensitive element of a rupture disc device.
- A ***rupture disc holder*** is the structure which encloses and clamps the rupture disc in position.
- The ***manufacturing design range*** is a range of pressure within which the marked burst pressure must fall to be acceptable for a particular requirement as agreed upon between the rupture disc manufacturer and the user or his agent.
- The ***specified disc temperature*** supplied to the rupture disc manufacturer shall be the temperature of the disc when the disc is expected to burst.
- A ***lot*** of rupture discs is those discs manufactured of a material at the same time, of the same size, thickness, type, heat, and manufacturing process including heat treatment.
- The ***minimum net flow area*** is the calculated net area after a complete burst of the disc with appropriate allowance for any structural members which may reduce the net flow area through the rupture disc device. The net flow area for sizing purposes shall not exceed the nominal pipe size area of the rupture disc device.
- The ***certified flow resistance factor,*** K_R is a dimensionless factor used to calculate the velocity head loss that results from the presence of a rupture disc device in a pressure relief system.

RUPTURE DISC PERFORMANCE REQUIREMENTS

The ASME Code provides requirements for rupture disc performance and does not have provisions for tolerances greater than indicated.

- The burst pressure tolerance at the specified disc temperature shall not exceed ±2 psi for marked pressures up to and including 40 psi and ±5% for marked burst pressures above 40 psi.
- The rupture disc must be marked at a pressure within the manufacturing design range.

Rupture discs are typically manufactured to order where each order represents a lot. The ASME Code defines 3 methods of acceptance testing for rupture discs. The most common method requires that at least two discs from the lot be burst tested at the specified disc temperature. The results of these tests must fall within the rupture tolerance.

Technical Bulletin

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RUPTURE DISC SIZING METHODOLOGIES

The ASME Code defines three methodologies for sizing rupture disc devices. Details on sizing methods can be found in technical bulletin TB8102.

The coefficient of discharge method (K_D) uses the calculated flow capacity of the device based on the minimum net flow area (MNFA) and then de-rates that capacity by a K_D of 0.62. This method is applicable only under the following conditions:

- The disc discharges to atmosphere
- The disc must be installed within 8 pipe diameters of the vessel nozzle
- The length of discharge piping must not exceed 5 pipe diameters
- The nominal diameters of the inlet and outlet lines are equal to or greater than the nominal diameter of the device.

This sizing method incorporates not only the rupture disc device but also takes into account the vessel nozzle, inlet piping, and exit piping for a simple system within the constraints shown.

The ***resistance to flow method*** (K_R) has been adopted by the ASME Code for sizing relief systems when other methods do not apply. The rupture disc is treated as just another piping component within the relief system. The resistance of the rupture disc is denoted by a K_R valve established by test during the certification process. The ASME Code requires that the calculated relieving capacity of the system be multiplied by 0.90 to allow for uncertainties inherent in this method.

Due to the variation in the opening characteristics of many rupture disc types between compressible and incompressible media the flow resistance for a given rupture disc is given as a K_{RG} (for gas), K_{RL} (for liquid), and/or K_{RGL} (for gas or liquid). Since the opening, and subsequently the flow resistance, is primarily determined by the initial opening characteristics, it is recommended that the K_R value be selected based on the state of the media directly in contact with the rupture disc at the time of rupture. A listing of Fike K_R values can be found in TB8104.

The ***combination capacity method*** is applicable when a rupture disc device is used upstream of a pressure relief valve (PRV) in conjunction with the requirements as noted below. The PRV is sized using normal sizing procedures and then the capacity of the valve is de-rated by the default combination capacity factor of 0.90. The rupture disc size must be equal to or greater than the nominal pipe size of the PRV inlet.

Alternatively to the default combination capacity factor, a certified combination capacity factor can be established by testing specific rupture disc / pressure relief valve combinations and registering these test results with the National Board of Boiler and Pressure Vessel Inspectors (National Board). A listing of Fike certified combination factors can be found in technical bulletin TB8103.

MANUFACTURER CERTIFICATION

The ASME Code has provisions for the application of the UD Code symbol to rupture disc devices. The authorization to use the UD stamp is based on an audit by the ASME designee (National Board) of various manufacturing, testing, and quality assurance systems. This audit is repeated at a minimum of every 3 years to insure ongoing compliance.

RUPTURE DISC DEVICE CERTIFICATION

In order to apply the UD symbol, the rupture disc device family must successfully complete:

- Flow resistance certification tests using either;
  - the default K_R value of 2.4
  - 1 size method
  - 3 size method
- Demonstration of manufacturing, testing, and quality control processes of representative production discs, witnessed by the ASME designee (National Board). This demonstration is repeated every 5 years for each product family certificate.

- The 1 size method consists of bursting and flow testing 3 pieces of 1 size of a device design at the minimum burst pressure for that size. This results in a certified K_R value that can be used for that size only and for pressures equal to or greater than the tested pressure.

- The 3 size method requires bursting 3 discs from 3 different sizes within a product family as the minimum burst pressure for each size. The resulting K_R value can be used for all sizes and pressures of the product family, however for the tested sizes the burst pressure must be equal to or greater that the tested pressures.

- Certified K_R value cannot be less than the average flow resistance plus 3 times the average of the absolute values of the deviations of individual flow resistances from the average flow resistance.

RUPTURE DISC MARKING REQUIREMENTS

The ASME Code defines the minimum requirements for marking of rupture disc devices. The following information is marked on the rupture disc tag for discs certified to the 1997 Addenda or later versions of the ASME Code.

- Manufacturer's Name
- Model or Part Number
- Lot Number
- Disc Material
- Nominal Size
- Marked Burst Pressure
- Specified Disc Temperature
- Minimum Net Flow Area
- Certified Flow Resistance K_{RG}, and/or K_{RL}, and/or K_{RGL}
- Year Built (or code)
- ASME UD Symbol

The following information is marked on the holder tag.

- Manufacturer's Name
- Model or Part Number
- Size
- Flow Direction
- Year Built (or code)
- ASME UD Symbol

ASME APPLICATION REQUIREMENTS

The ASME Code defines certain sizing and pressure rating criteria for various applications of rupture discs. In the case of primary relief or sole relieving device (shown in fig. 1), it must be sized to prevent the pressure in the vessel from rising more than 10% or 3 psi, whichever is greater, above the maximum allowable working pressure (MAWP). In addition, the rupture disc marked burst pressure shall not exceed the MAWP.

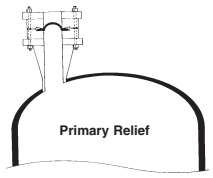

Figure 1 — Primary

The ASME Code allows rupture disc devices to be used in ***multiples or*** as a ***secondary device*** to other rupture disc devices or pressure relief valves (shown in fig. 2). In this case, the secondary device is sized to prevent the pressure in the vessel from rising more than 16% or 4 psi, whichever is greater, above the MAWP. The burst pressure of the secondary device may be marked at a pressure not exceeding 105% of the MAWP.

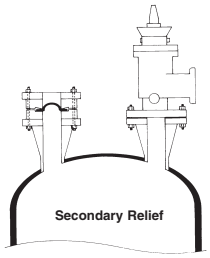

Figure 2 — Secondary

Another application allowed by the ASME Code is the use of a ***rupture disc in combination with a pressure relief valve*** (shown in fig. 3). In this application, the rupture disc device seals the pressure relief valve from the vessel contents or downstream vapors. The disc/valve combination may be used as a primary or secondary relief device. The ASME Code provides guidelines for the use of disc/valve combinations.

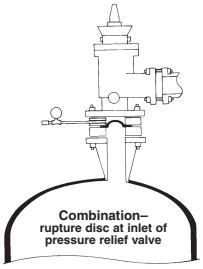

Figure 3 — Combination

A rupture disc may be installed between a pressure relief valve and the vessel provided:

- The combination provides ample capacity to meet the overpressure requirements.
- The marked capacity of the valve is de-rated by a combination capacity factor of 0.90 or a factor certified for the specific disc/valve combination.
- The space between the rupture disc and valve is provided with a pressure gage, try cock, free vent, or suitable telltale indicator. This arrangement must be capable of detecting a leak and/or preventing a buildup of pressure in the space because any pressure buildup will affect the relieving pressure on the process side of the disc.

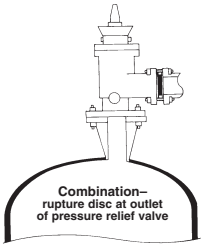

Figure 4 — Combination

A rupture disc may also be installed on the outlet of a pressure relief valve provided:

- The space between the valve and rupture disc is vented or the valve is designed so any accumulated pressure on the outlet of the valve will not affect the opening pressure of the valve.
- The marked burst pressure of the disc plus any downstream backpressure does not exceed the set pressure of thevalve.
- The rupture disc provides sufficient capacity to permit flow through the valve without exceeding the allowable over pressure.
  The bonnet of the relief is vented.

When an additional hazard can be created by excessive pressure buildup due to exposure of a pressure vessel to ***fire or other unexpected source of external heat***, rupture disc devices may be applied. These devices must be sized to prevent the pressure in the vessel from rising more than 21% above the MAWP. The burst pressure may be marked at a pressure not exceeding 110% of the MAWP.

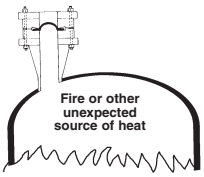

Figure 5 — External Fire

When a rupture disc device is primarily intended to protect a pressure vessel against exposure to ***fire or other unexpected sources of external heat***, and when the vessel has no permanent supply connection, and when the vessel is used for storage of non-refrigerated liquefied compressed gasses at ambient temperatures, then the rupture disc device shall be sized to prevent the vessel pressure from rising more than 20% above the MAWP. The marked burst pressure shall not exceed the MAWP.