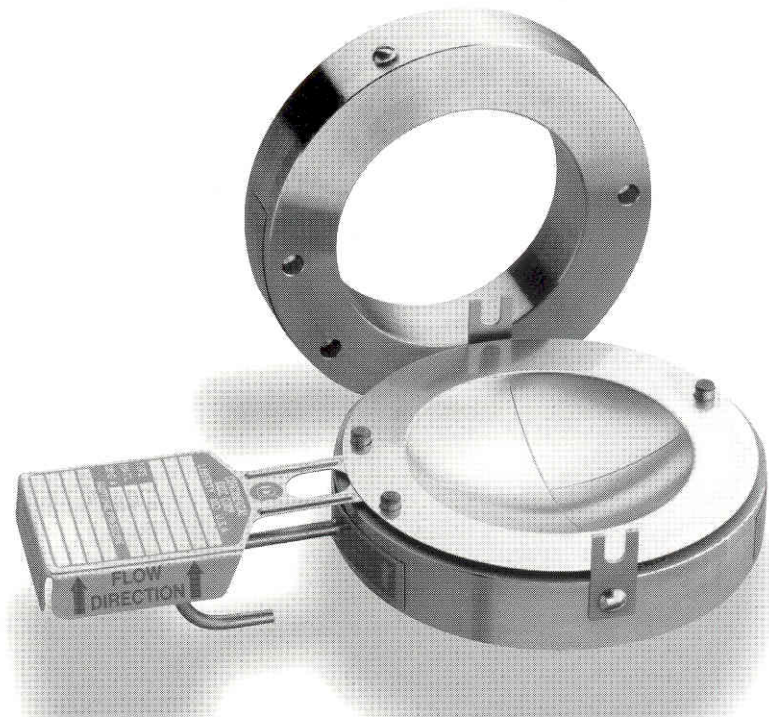

Rupture Disk Application & Inspection, 2015 Update

Prepared by Joseph F. Ball, P.E.



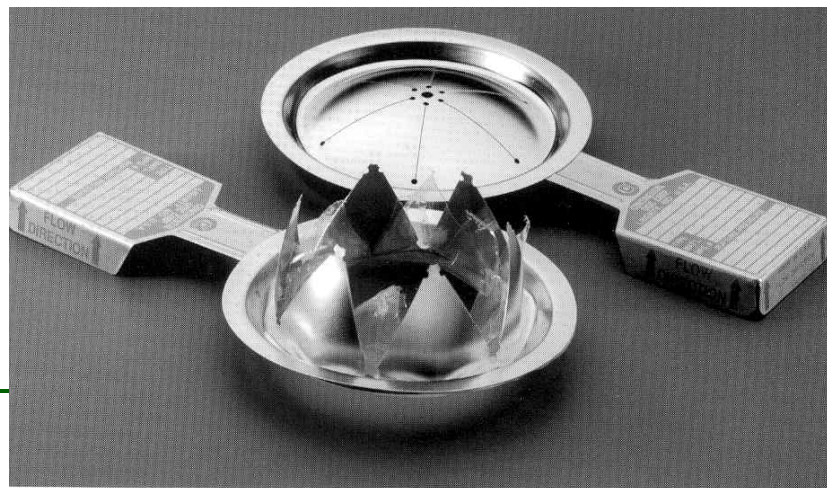
What is a Rupture Disk Device?

- A Rupture Disk Device is a non-reclosing pressure relief device actuated by inlet static pressure and designed to function by the bursting of a pressure containing disk.
- It consists of a rupture disk (pressure sensitive element which actuates) and a rupture disk holder (clamps disk in position).



Types of Rupture Disks

- Forward acting -
actuates in tension
 - Solid metal
 - Scored
 - Composite

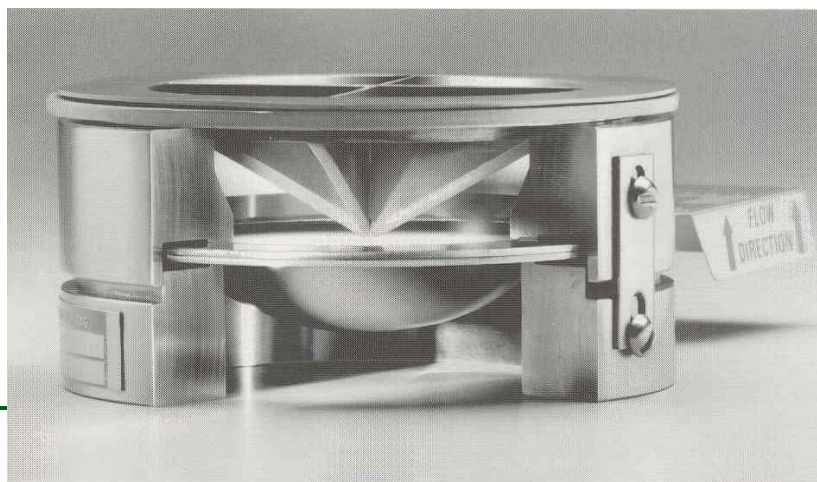


Types of Rupture Disk Devices

- Reverse acting -
actuates in
compression

Knife blade

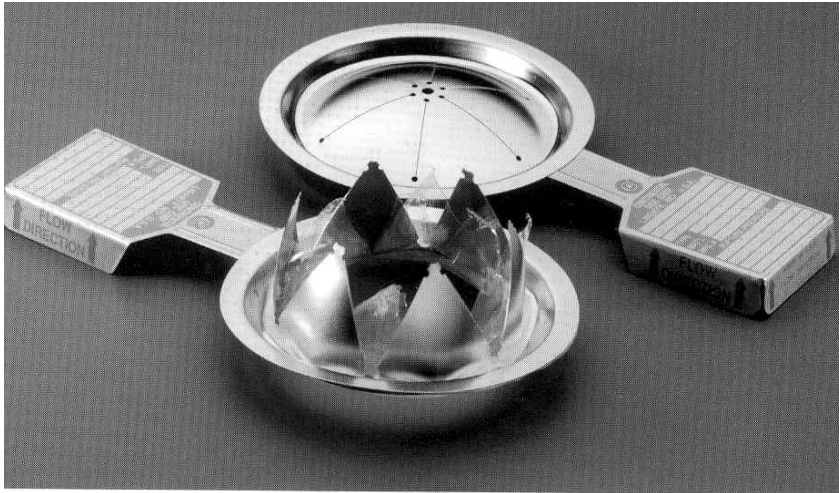
Scored



ZAP Insert Assembly



Rupture Disk Materials



- Metal - Stainless steels, nickel, monel, hastelloy, aluminum, inconel, gold, silver, tantalum
- Non-metallic - graphite, other plastics
- Composite - Teflon seal with metal support
- Various liners and coatings for corrosion protection



Rupture Disk Application

- Protection of pressure vessels as sole pressure relief device
- In parallel with pressure relief valves as emergency protection

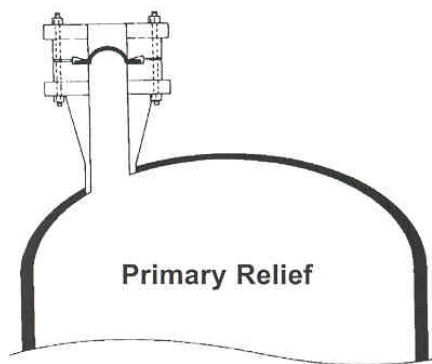


Figure 1 — Primary

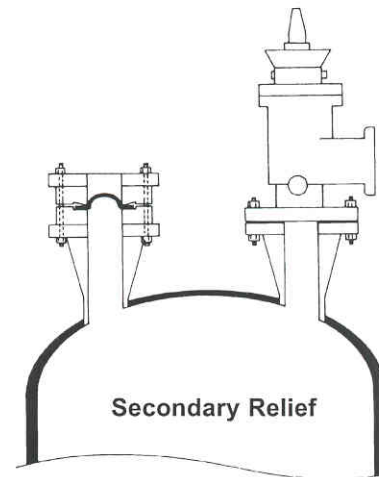


Figure 2 — Secondary



Rupture Disk Application

- In series with a pressure relief valve inlet to prevent leakage

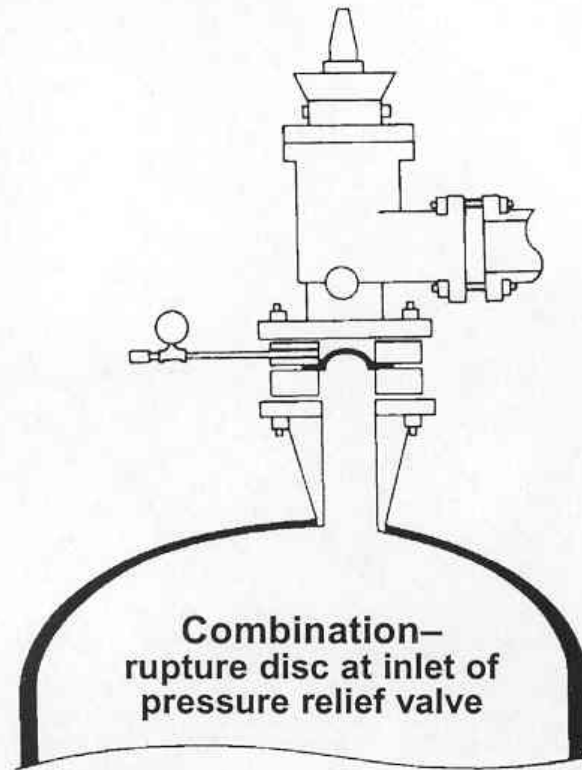


Figure 3 — Combination



Rupture Disk Application

- In series with a pressure relief valve to protect the outlet from contamination

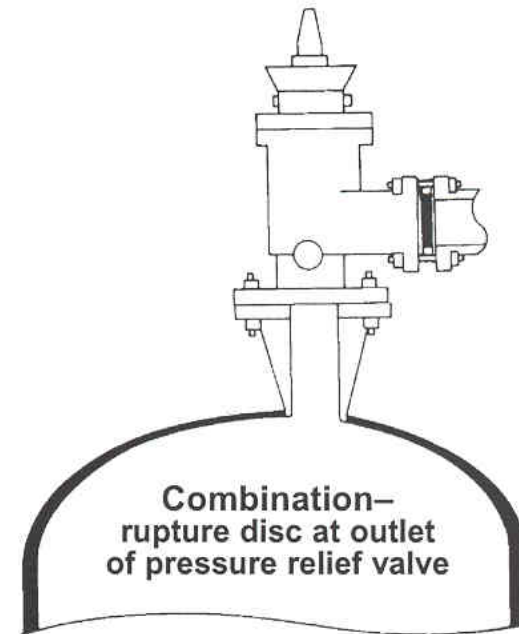


Figure 4 — Combination



Section VIII Requirements

- 1. Marked burst pressure shall not exceed MAWP of vessel (for single device). (UG-134(a))
- 2. Burst pressure is established at “specified disk temperature”.(UG-127(a))
- 3. Specified disk temperature shall be the temperature of the disk when the disk is expected to burst. (Note 48)
- 4. Certification is valid only for disk and holder from the same manufacturer



Capacity Requirements

- User is responsible for installing proper pressure relief devices. (UG-125(a)(2))
- Capacity of relief system must prevent pressure from rising above specified overpressure limits. (UG-125 (c))
- Capacity of relief system, including the effects of both the rupture disk and all piping, must exceed the system capacity.



Capacity Requirements (cont.)

- Two methods of calculating capacity:
- Simplified method for short discharge pipes:
 - - “8 and 5 rule”
 - - Capacity calculated the same as for valves with $K = 0.62$ and area = Minimum Net Flow Area (MNFA)



Capacity Requirements (cont.)

- 2. More involved systems must be calculated by analyzing the total “resistance to flow”.
- Uses flow resistance of all pipes, valves, tees, reducers and certified K_r value.
- Estimated relief system capacity is multiplied by 0.9 as safety factor.
- System relief capacity must exceed system capacity.



Marking Requirements

UG-129(e)

- ASME Certification mark with UD designator
- Disks are marked with:
 - Manufacturer's name
 - Type number
 - Burst pressure
 - Specified temperature
 - K_{RG} , K_{RL} , K_{RGL} value(s) and MNFA (or capacity)
 - Lot no.
 - Disk material
 - Size
 - Year built or date code



Marking Requirements



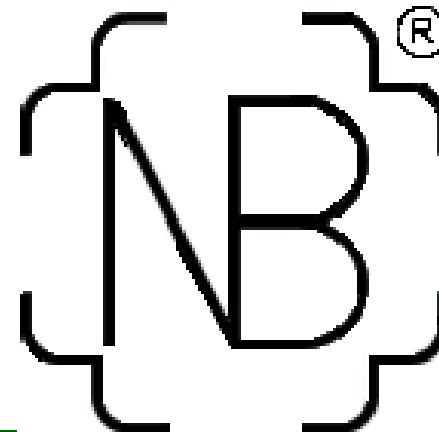
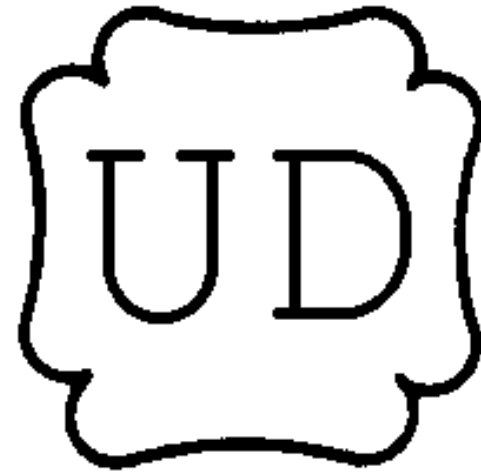
UD

- ASME Certification Mark
- “Designator” gives service
- V, HV, UV, or UD for pressure relief devices



Marking Requirements

- Older disks will have “UD” Stamp
- “NB” mark indicates device is certified for capacity



Marking Requirements cont.

- Marking of holders

 - Manufacturer's name

 - Design or type no.

 - Size

 - Certification mark with designator

 - Year built

 - Flow direction



Inspection of Rupture Disks,

NBIC Part 2, 2.5.2, 2.5.3, 2.5.5.3

- 1. Compare marked burst pressure to vessel MAWP.
- 2. Compare marked disk temperature to system relief temperature.
- 3. Check general condition of installation.
- 4. Check that marked flow direction is correct.



Inspection of Rupture Disks



- 5. For combination installations check pressure gage or tell-tale indicator to make sure there is no pressure between the disk and valve.
- Pressure indicates the disk is leaking (or has burst) and must be replaced.



Inspection of Rupture Disks

- 6. For combination installations, the disk will be at least as big as the pressure relief valve size. (UG-135(b)(1))
- 7. Proper disk for the service medium
 - K_{RG} indicates gas service
 - K_{RL} indicates liquid service
 - K_{RGL} indicates service could be gas or liquid



Other Installation Issues

- Material appropriate for intended service
- Operating margin (or ratio) correct for disk type selected
- Possibility of vacuum in vessel or back pressure on disk



Areas for Caution

- Specified disk temperature is NOT the temperature marked on the vessel nameplate.
- A disk marked for the vessel nameplate temperature will probably burst out of the specified burst tolerance and ABOVE the MAWP.



Areas for Caution

- “Manufacturing design range” can cause disk burst pressure to exceed MAWP.

Manufacturing design range is a range of pressures within which the marked burst pressure must fall to be acceptable for a particular requirement as agreed upon between the Manufacturer and the user. (Note 47)



Areas for Caution

- Example: Continental Disk Standard type has a manufacturing range of -4%/+7% for set pressures of 101 to 500 psig.

Disk is ordered for 250 psi. Could be stamped anywhere from 240 to 267.5 psig depending upon test burst pressures.

Solution: Order disk rated for 233.6 psig. Max. set will be 250.



Areas for Caution

- Manufacturing design range is *not* the burst tolerance.
- Order replacements by previous lot number, not previous set pressure!



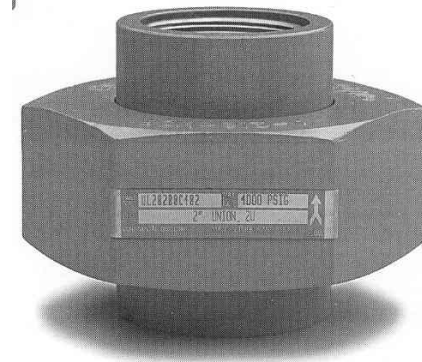
Code History

- Code Certification Introduced in 1998 Code
- 2001 Addenda revised K_R to K_{RG} or K_{RL} , or K_{RGL}
Subscript indicates K_R is valid for gas, liquid, or both
Burst test for Certification is performed on applicable fluid to establish opening characteristic
- 2005 Addenda required holders to be UD stamped
- 2006 Addenda allowed multiple K_R values



Other Provisions

- UG-129(e)(1) permits use of serial number and loose tag for rupture disk fully enclosed in a holder or system (was Code Case 2367, incorporated in 2015 edition)
- Permits disks to be used with tag sealed to installation and traceable by lot number

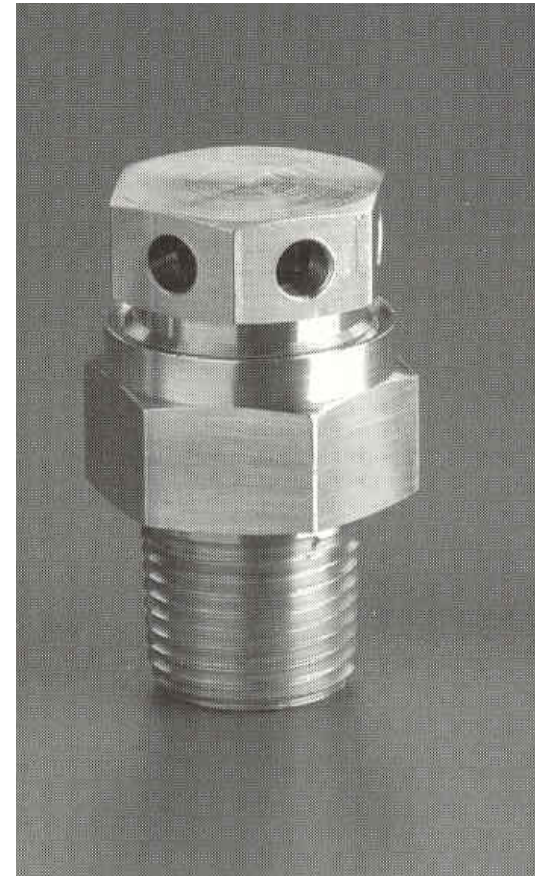


#2U Holder
Threaded Inlet - Threaded Outlet



Other Provisions

- UG-131(a) permits certification of devices to be certified for capacity (was CC-2395)
- Used primarily for “muffled” devices
- These devices will be stamped a capacity instead of K_R



Section VIII, Div. 3

- KG-311.4 User establishes needed design pressure – this establishes basis for PRD set pressures
- KG-311.11 User (or agent) responsible for design, construction and installation of overpressure protection system
- KG-311.13 User shall establish the location and applicable Jurisdiction for the vessel



Section VIII, Div. 3

- KR-120 Protection can be provided by PRVs, rupture disks, flow paths or vents, inherent overpressure protection
- KR-6 permits Power actuated pressure relief systems (was Code Cases 2378,2530, 2561)
- May use Overpressure protection by system design per Division 1, UG-140 (KR-600(b))



Section VIII, Div. 3 2015 updates

- Rupture disks shall carry UD or UD3 (new) designator
- UD disks shall have holder marked with “*DIV3*” (must be built with material meeting Div. 3)
- Disk and holder may be from different manufacturers (KR-200(a)(2))



Section VIII, Div. 3

2015 updates

- No capacity certification testing required
- Burst pressure demonstration is required for UD3 designs
- **Jurisdictional issue:** Certified disk or valve availability



Conclusion

- These unique devices fill a special overpressure protection need
- Differences must be recognized when they are applied by users or checked by Inspectors



Thank You!

- Graphics courtesy of BS&B, Fike Corp. and Continental Disk Corp.
- *Pressure Relief Device Certifications (NB-18)* contains a listing of Certified Rupture Disk devices available on the National Board Web page: www.nationalboard.org

