Rupture Disk Application & Inspection, 2015 Update

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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
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
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)
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

- 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.
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
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](http://www.nationalboard.org)