RUPTURE DISC TERMINOLOGY & CONCEPTS

ASME – (American Society of Mechanical Engineers) – A recognized standard to which most rupture disc manufacturers build their products.

ACTUAL BURST PRESSURE – This is the actual pressure in the system when the rupture disc bursts. This pressure would ordinarily be the same as the Stamped Burst Pressure, unless the disc was improperly installed or damaged. Back pressure on the disc would likely cause a deviation from Stamped Burst Pressure.

COMPRESSION LOADED – A compression loaded rupture disc is installed into a system so that the normal operating pressure is on the convex or raised side of the formed crown. An example of a compression loaded rupture disc would be a reverse buckling system.

DIFFERENTIAL PRESSURE – A rupture disc is a differential pressure device. The disc will burst when the differential pressure across it exceeds the stamped burst pressure. If the system has back pressure, this must be added to the stamped burst pressure to calculate the true rupture pressure.

DAMAGE RATIO – A damaged rupture disc will burst at some pressure other than that predicted. This disparity can be reported by a value called the damage ratio. The damage ratio is equal to Actual Burst Pressure of a damaged disc, divided by the Stamped Burst Pressure. A damage ratio of 1 or less assures your client that the disc, even damaged, will burst at or below the stamped burst pressure, while a value higher than 1 would indicate the actual burst pressure could exceed the stamped burst pressure. As an example, a damaged disc with a 100 psig stamped burst pressure and a damage ratio of 1.5 could have an actual burst pressure of 150 psig.

DISC NOMENCLATURE

- CRC - Composite railcar disc, slotted top, non-fragmenting, 80% operating ratio.
- FAS - Forward acting cross scored, non-fragmenting, 90% operating ratio.
- FASS - As per FAS but for sanitary applications.
- (F)CO - Composite rupture disc, slotted top, with a fluoropolymer / metal seal, non-fragmenting, 80% operating ratio.

- FLCO - Flat low-pressure composite, slotted top, non-fragmenting, 50% operating ratio.
- FLCOS - As per the FLCO but with a built in sensor.
- FRDI - Insert rupture disc holder for FAS, (F)CO and FST rupture discs.
- FRDI(P) - Pre-torqued insert holder.
- FST - Tension loaded, cross scored, non-fracturing, 85% operating ratio.
- GRO - Flat, peripherally scored, non-fragmenting, 60% operating ratio.
- HCL-RC - Hydrochloric acid railcar disc, fragmenting, 50% operating ratio.
- ICD - Intermodal container disc, cross scored, non-fragmenting, 90% operating ratio.
- Opti - Insert rupture disc holder for Opti-Gard.
- Opti-Gard - Peripherally scored, non-fragmenting, 95% operating ratio, uses FloTel integral sensor.
- OTU - One time unit assembly.
- PCR - Precision cut reverse buckling, cross scored, non-fragmenting, 90% operating ratio.
- PCRS - As per PCR but smaller for sanitary applications.
- PLR - Precision low-pressure, non-fragmenting, 90% operating ratio.
- POSIPRO - Dual action low pressure relief, for positive over pressure and vacuum relief, slotted top, fragmenting, 90% positive, 80% vacuum operating ratio.
- POSIPRO-S - As per the POSIPRO but for sanitary applications.
- POSI - Holder for POSIPRO.
- POSS - Holder for POSIPRO-S.
- PSR - Compression load, reverse buckling, non-fragmenting, 90% operating ratio.
- PRDI - Insert rupture disc holder for PRO+, PLR and PCR rupture discs PRDI(P) Pre-torqued insert holder.
- PRO+ - Precision reverse-operating, peripherally scored, non-fragmenting, 95% operating ratio, excellent flow characteristics (Kr).
- PROS - As per PRO+ but for sanitary applications.
- RDI - Insert rupture disc holder with a 30° seat for STD and CO discs. SDA Soldered disc assembly.
- SRC - Scored railcar disc, cross scored, non-fragmenting, 90% operating pressure.
- STD - Standard, no scoring, fragmenting, 70% operating ratio.
- TDH - Threaded rupture disc holder.

- Union - Union rupture disc holder.
- VAPRO - Dual action pressure relief, for positive over pressure and vacuum relief, slotted top, fragmenting, 80% positive, 90% vacuum operating ratio.
- VAPRO-S - As per VAPRO bur for sanitary applications.
- VRDI - Holder for VAPRO.
- VRDS - Holder for VAPRO-S.
- WDA - Welded disc assembly

ENVIRONMENTAL TESTING – A test break in ovens to simulate the operating temperature under which the disc will be expected to perform. For example, and Oseco FAS disc is ordered with a specific burst pressure at a specific temperature. One or more test breaks would be performed in an environmental oven to verify the disc would indeed break at that combination of events.

FINDING PROCESS – The Finding Process is a controlled, experimental procedure that the craftsmen go through to achieve a burst pressure within the manufacturing range. The disc fabricator uses mathematical formulas, statistical process controls, and historical records to find a particular burst pressure.

FAILSAFE – Refers to a disc with a Damage Ratio and a Reversal Ratio of 1 or less. If a disc is damaged or installed upside down, the disc will still open at or below the Stamped Burst Pressure.

KR VALUE - The concept of a loss coefficient "K" has been used for many years to define piping system "minor" losses due to elbows, tees, fittings, valves, reducers, etc. Therefore, K is the pressure loss expressed in terms of the number of velocity heads. While K is technically dependent upon the component geometry and Reynolds number, the dependence is strongest to geometry in fully developed turbulent flow. There are several sources that can provide $K_{entrance}$, K_{elbow}, K_{pipe}, and K_{exit}. Prior to the 1998 revision of the ASME Code, the engineer did not have a reliable source of KR for the rupture disc. API RP521 gave an estimate of 1.5 for KR, regardless of disc design, etc. In most cases this was a conservative value. However, as evidenced by the National Board Red Book, there are several discs with rated KR above this value.

MANUFACTURING LOT - A "Lot" consists of all the discs on an order that are of like size and style with the same burst pressure and temperature requirements. In other orders, they are identical.

MANUFACTURING RANGE – ASME describes manufacturing range as follows: "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 rupture disc manufacturer and the user or his agent." (UG-127 Foot Note 46)

The manufacturing range is predetermined, allowable deviation from the Request burst pressure, within which the stamped burst pressure may fall and still be considered acceptable to the manufacturer and user. It's similar to tolerances on machined parts. Manufacturing ranges are published in the catalog by product type. Each disc style has its own table of manufacturing ranges.

An example of manufacturing range for Standard or Composite disc might be as follows: Assume a requested burst pressure of 100#, and a manufacturing range between +10% to -5%. This order of discs could be produced with a stamped burst pressure anywhere from 110# to 95#, and would be considered "good parts" within the range. Keep in mind, every disc in the lot would be stamped at the same burst pressure.

Often the manufacturing range can be adjusted by shifting the entire range to the minus side of the requested burst pressure. Using our example above, the total 15% manufacturing range can be shifted to the minus side. Now the 100# requested burst pressure would be the maximum possible and the stamped burst pressure on the disc would fall between 85# and 100#. As before, every disc in the lot would be stamped at the same burst pressure. In some cases, ½ or ¼ range discs are available.

The manufacturing range for pre-scored rupture discs, such as Oseco's PCR and FAS disc are usually expressed as 10%, 5% or even 0% ranges. A 0% range rupture disc has a stamped burst pressure exactly as ordered without deviation. Scored rupture disc ranges are always on the minus side. For example, the stamped burst pressure for a 100# FAS disc with a 5% manufacturing range would fall from 95# to 100# inclusive.

MODEL NAMES – When describing an Oseco rupture disc with options, we usually use descriptive abbreviations such as COV or RSTDR. These abbreviations are assigned from the top down. Possible accessories include [R]ings, [L]iners, and [V]acuum supports. Using this system, you would know that a RCOV would mean a [R]ing on top of a [CO]mposite Disc with a [V]acuum support underneath.

NON-FRAGMENTING – Some styles of discs are designed to burst or rupture without producing pieces. Others are designed to produce minimal fragmentation.

OPERATING RATIO – The operating ratio refers to the relationship between normal operating pressure and stamped burst pressure. Operating ratio is usually expressed as a percentage and varies with the style of disc. If the operating ratio is

exceeded, the service life of the disc will be reduced. For good service life, the disc must be operated at or below its operating ratio. For example, an Oseco Standard Disc has an operating ratio of .7 or 70%. This means that the disc should not be operated at more that 70% of the stamped burst pressure for good service life. Other discs such as the FAS or PCR have a .9 or 90% operating ratio. It is important to consider the operating ratio when selecting a rupture disc.

Using an example, let's look at the relationship of these factors. Assume you are going to protect a vessel with a MAWP of 500 psig and a normal operating pressure of 410 psig. You have chosen the FAS scored rupture disc because it is non-fragmenting. Your requested burst pressure is 500 psig. Now we will have to consider the manufacturing range. If you ordered the disc with a 10% manufacturing range (10%, 5% and 0% available), your discs could have a stamped burst pressure of 450 psig to 500 psig. Let's assume the "worst case" in which the stamped burst pressure is 450 psig. Because the operating ratio is 90%, the normal operating pressure on this disc should not exceed 405 psig, which is 5 psig lower than the 410 psig your system requires. You would need to order a 5% manufacturing range to properly satisfy the requirements in this example.

PRE-BULGED – Forming the rupture disc at the plant into its traditional crowned shape.

PSIG - (pound-force per square inch gauge) is a unit of pressure relative to the surrounding atmosphere. By contrast, psia (pound-force per square inch absolute) measures pressure relative to a vacuum (such as that in space). At sea level, Earth's atmosphere actually exerts a pressure of 14.7 psi. Humans do not feel this pressure because the internal pressure of their bodies matches the external pressure. If a pressure gauge is calibrated to read zero in a vacuum, then at sea level on Earth it would read 14.7 psi. Thus, a reading of 30 psig on Earth represents an absolute pressure of 44.7 psi. More generally, x psig + 14.656 = x psig.

REVERSAL RATIO – Reversal Ratio is equal to the Actual Burst Pressure of a rupture disc installed in reverse divided by the Stamped Burst Pressure. If the value is 1 or less, the disc will relieve at or below its Stamped Burst Pressure, even when installed in reverse. If the value is greater than 1, the Actual Burst Pressure will be greater than the Stamped Burst Pressure.

RUPTURE TOLERANCE – The term Rupture Tolerance applies to the amount of acceptable deviation between the stamped burst pressure and the actual burst pressure. ASME requires that the variance no be greater than +/- 5% at the specified disc temperature for pressures above 40 psig. 40 psig and lower requires a rupture tolerance of +/- 2 psig.

STAMPED BURST PRESSURE – Often called the Set Pressure or Rupture Pressure. This is the pressure stamped on the tab which states at what point the disc is designed to open. A specified disc temperature will be stamped in the tab with the Set Pressure, as required by the ASME code.

STANDARD RUPTURE DISC MATERIALS – Oseco's standard rupture disc materials include 316 Stainless Steel, Nickel 200, Inconel 600, Monel 400, and Aluminum. Other materials suitable for the construction of rupture discs include Tantalum, Hastelloy C, Silver and Gold plated materials, and various plastics like Ryton. Fluoropolymer is normally used for liners, slit slot covers, and nonmetal seals.

SPECIFIED DISC TEMPERATURE – The temperature specified by the customer at which the disc is expected to burst. The burst pressure at this temperature will be stamped on the tag of the disc.

TENSION LOADED – A tension loaded rupture disc is installed in a system so that the normal operating pressure is on the concave or cupped side of the pre-bulged crown. When the material of construction reaches its yield point, the disc will burst open to relieve the trapped pressure.