The McIlvane Company Hot Topic Hour

Valves for Power Plant Steam and Cooling Water - June 2, 2011

PREVENTION OF VALVE

CENTER CAVITY OVERPRESSURIZATION

AND

THERMAL BINDING:

Key Concerns in Power Plant Design and Operation

Don Bowers – V.P. Sales & Marketing
Weir Valves & Controls, USA

ALLEN STEAM TURBINES
Single & Multi-stage Steam Turbines

ATWOOD & MORRILL
Engineered Isolation & Check Valves

BATLEY VALVE
High Performance Butterfly Valves

BLAKEBOROUGH
Control & Severe Service Valves

HOPKINSONS
Parallel Slide Gate & Globe Valves

HYDROGRITTER
De-Gritting Machines

MAC VALVES
Ball & Rotary Gate Valves

ROTO-JET PUMP
High Pressure Pitot Tube Pumps

SARASIN-RSBD
Pressure Safety Devices

SEBIM
Nuclear Valves

TRICENTRIC
Triple Offset Butterfly Valves

WEMCO PUMP
Extra Heavy Duty Vortex Pumps

WEMCO SELF PRIMER
Solids Handling Self Primer Pumps

WEIR POWER & INDUSTRIAL SERVICES™

Excellent
Power & Industrial
Solutions

WEIR POWER & INDUSTRIAL

Prevention of Center Cavity Overpressurization & Thermal Binding

Weir Valves & Controls-USA was founded as the Atwood & Morrill Company in 1900. Joining forces with Hopkinsons Valve and then with the Weir Group in the 1990's, WVC-USA has evolved into a global leader in designing and manufacturing a range of high quality isolation valves used in power, process, refining, oil & gas and pulp & paper industry applications.

Known for our ability to handle tough applications in power, WVC-USA's parallel slide and Y-Pattern globe valves are used around the world in main steam, feedwater, by-pass and other difficult services. Our reverse current, steam extraction check valves are the industry leader for turbine steam extraction lines. WVC's robust designs are noted for dependability and service life, and our aftermarket service is exemplary.

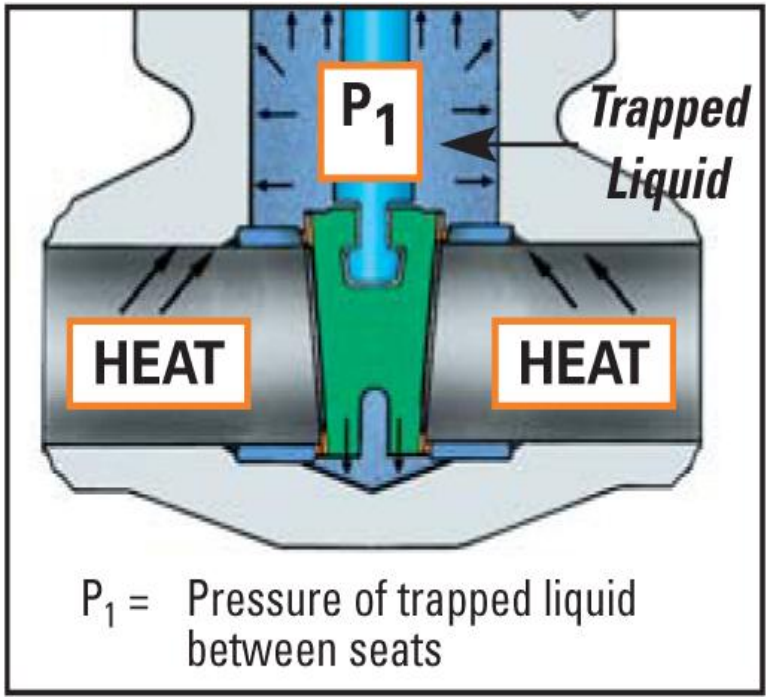
WEIR POWER & INDUSTRIAL

Prevention of *Center Cavity Overpressurization* & Thermal Binding

Center Cavity Overpressurization (CCOP) & Pressure Locking

Applicability and Definitions

CCOP may be defined as a build-up of pressure in the center cavity of a valve (having two seats) caused by the heating of fluid which has been trapped between the seating surfaces. Such pressure may make opening the valve more difficult, and in extreme cases, render the valve inoperable.



Velan Publication *VEL-PS*

Prevention of *Center Cavity Overpressurization* & Thermal Binding

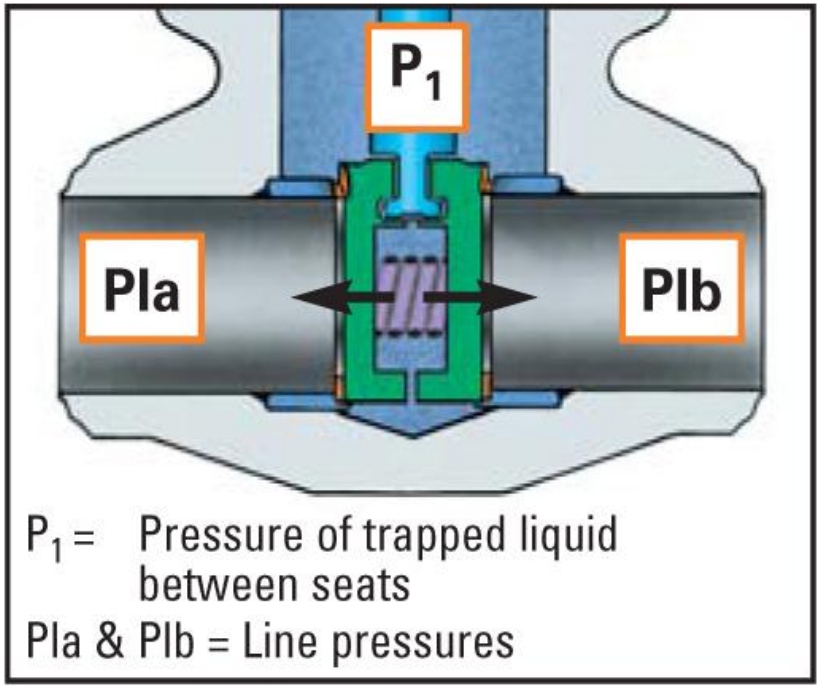
Center Cavity Overpressurization (CCOP) & Pressure Locking

Applicability and Definitions

Pressure locking may be defined as a decrease in upstream (Pla) and/or downstream (Plb) pressure, where the resultant increase in differential pressure (center cavity vs. upstream and/or downstream bores) is high enough to preclude the valve from opening.

ASME B16.34 (para. 2.3.3) assigns responsibility to the ***Owner or his designee*** to advise the Valve manufacturer of the potential for CCOP or pressure locking and specify a method to preclude occurrence.

These methods are as summarized herein.

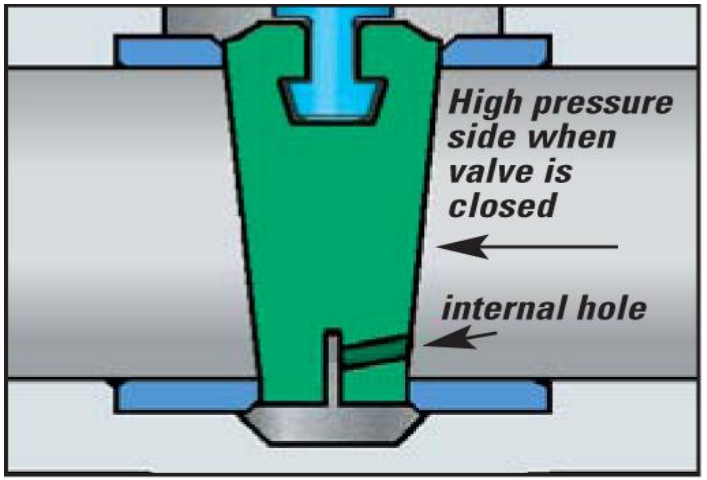


Velan Publication *VEL-PS*

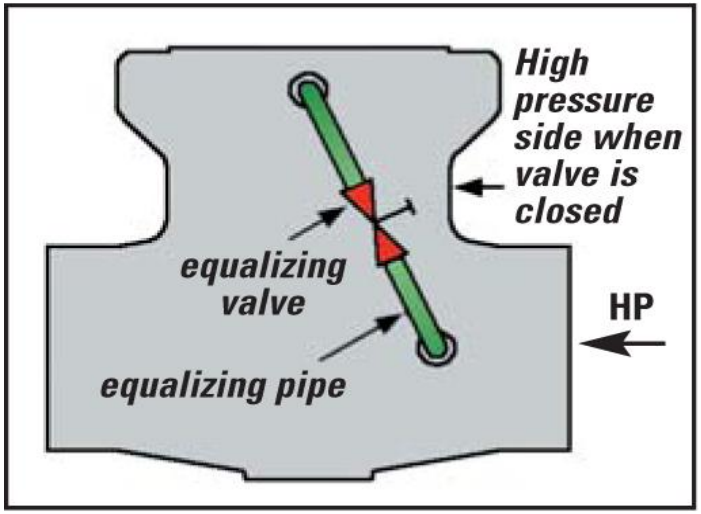
Prevention of *Center Cavity Overpressurization* & Thermal Binding

Methods of Guarding Against CCOP and Pressure Locking

An internal hole may be drilled in the wedge face connecting the body cavity to the pressure side of the valve. Note that this will render the valve uni-directional in its sealing ability. This method is the most commonly employed, and is typically the most cost effective.



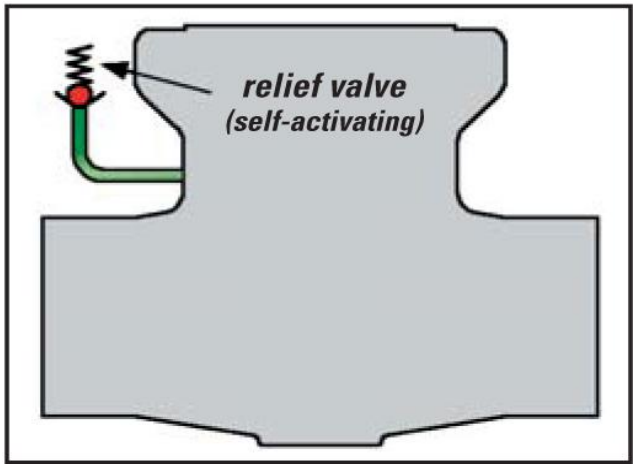
Install an equalizing pipe connecting the body cavity to the pressure side of the valve. Note that without an isolation valve installed in the pipe, the valve will be rendered uni-directional in its sealing ability.



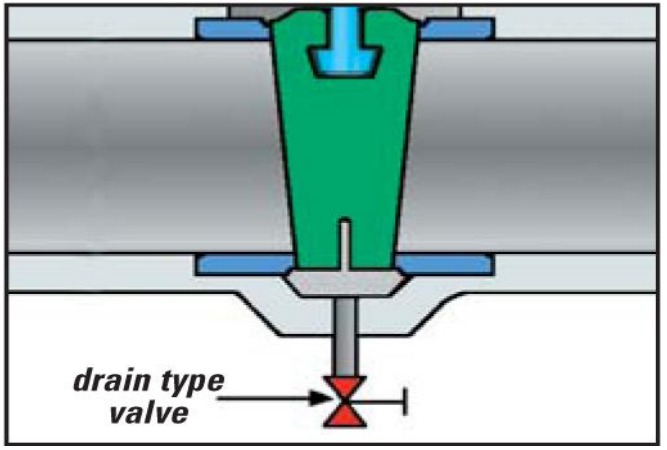
Prevention of *Center Cavity Overpressurization* & Thermal Binding

Methods of Guarding Against CCOP and Pressure Locking

Drill and tap a pipe/tube into the center cavity connecting to a pressure relief valve. At a predetermined set pressure, the valve will relieve the overpressure condition allowing normal valve operation. Note that this method maintains bi-directional sealing of the valve.

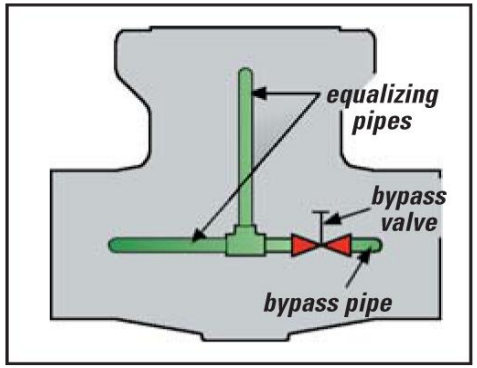


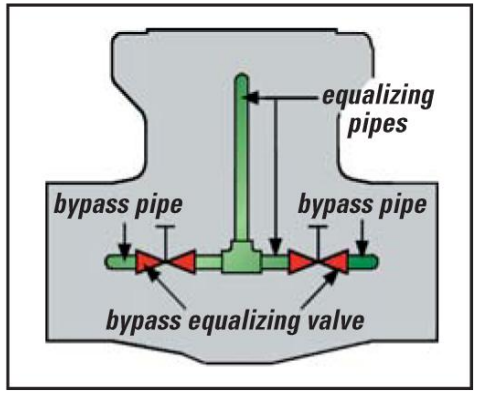
Drill and tap a pipe/tube into the center cavity connecting to a drain valve. Bi-directional sealing is maintained, but the drain valve must be opened in order to relieve overpressurization.

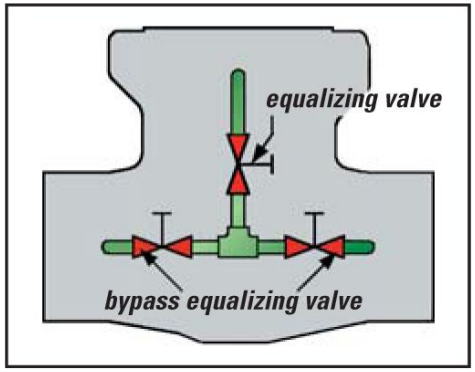


Velan Publication *VEL-PS*

Prevention of *Center Cavity Overpressurization* & Thermal Binding







Velan Publication *VEL-PS*

Guarding Against CCOP and Pressure Locking

Installation of combination equalizing pipe, bypass piping and bypass isolation valve configurations will maintain bi-directional sealing capability and also may be used for applications where the primary pressure side of the valve may change. Note that the placement of the isolation valves will permit relief of a variety of overpressure conditions

Prevention of Center Cavity Overpressurization & *Thermal Binding*

Thermal binding may occur in solid or flex wedge gate valves where temperature and/or operation modes may cause the wedge to bind against the valve's seat rings (precluding valve cycling) as a function of thermal expansion. It is most common in higher temperature applications, (@800 deg. F. and above) but has been noted to occur at lower temperatures. This phenomena may occur as a function of several different operating modes, including: (but not limited to)

- Where a temperature differential exists between the upstream and downstream bores of the valve (75-100 degrees F. or greater)
- During power plant start-up (combined cycle) where ramp up is accelerated precluding the possibility for system thermal equalization.
- Either close cold/open hot or close hot/open cold modes may result in thermal binding depending on a number of variables including, valve size, pressure class, material/thermal expansion, by-pass configuration, wedge design, heat sink considerations based on localized mass of the valve body/wedge, etc. Our experience has shown a higher incidence in the close hot/open cold mode.

WEIR POWER & INDUSTRIAL

Prevention of Center Cavity Overpressurization & *Thermal Binding*

The Owner or his Designee must analyze the operating conditions to determine if the potential for thermal binding exists. This analysis must take into consideration such variables as: (but not limited to)

- *Operating conditions (temperature and pressure)*
- *Type of valve being applied and manufacturer*
- *Mode of operation (base load, cycling, frequency of cycling, start-up duration, system where valve is installed, etc.)*
- *Mode of actuation*

The valve manufacturer should be involved in this evaluation, but, as a minimum, should be provided the results of the evaluation.

Where it is determined that the potential for thermal binding exists, or where it has been confirmed that valves in operation are becoming thermally bound, the following should be observed:

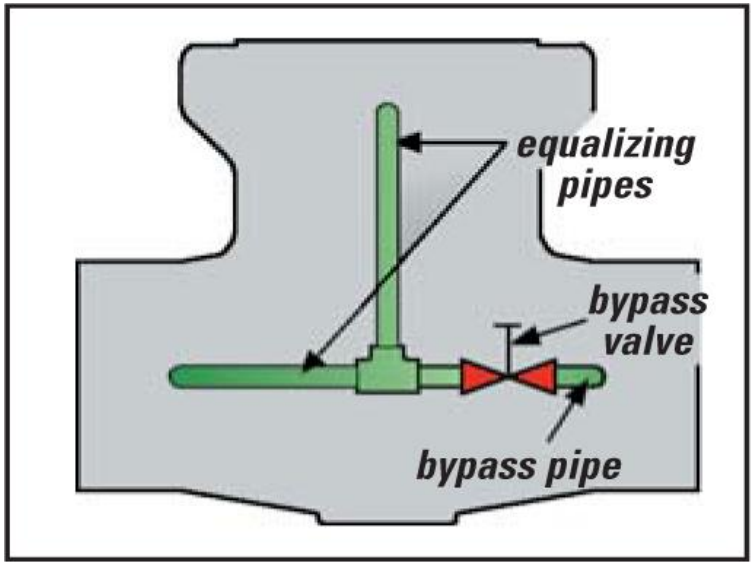
Prevention of Center Cavity Overpressurization & *Thermal Binding*

- ***Choose parallel slide valves.*** Parallel slide valves are not susceptible to thermal binding due to the disc travel allowed by the inconel spring(s) holding the discs apart.
- Experience indicates that flex wedge gate valves are less likely to become thermally bound if the plant system is brought up to @700-800 deg.F. for a period of time (plants where we have this experience allowed @2 hours) to allow for thermal equalization prior to opening these valves.
- **For valves already installed that are experiencing thermal binding** - reset the actuator to close on ***position*** vs. ***torque***. This is, in essence, an “instrument calibration” process, that must be done in accordance with established procedures by trained personnel.
- Recommend coordination of the logistical and commercial issues with Field Services.

WEIR POWER & INDUSTRIAL

Prevention of Center Cavity Overpressurization & *Thermal Binding*

- On the opening stroke, by-pass the torque switch for the first 5-10% of the valve's stroke. This will provide maximum torque to unseat the wedge. Be aware that the integral thermal protection switches for some actuators have to be integrated into the control system for them to be effective. Note that local thermal overloads at the valve/motor should not be bypassed by overall system overload at the DCS.
- Utilize integral by-pass to ensure a maximum 75-100 deg.F. differential temperature (delta T) between the valve inlet and outlet prior to opening. Verify this maximum delta T at the valve inlet and outlet. (i.e. On the valve itself and not further upstream or downstream)
- Valve closure speed not to exceed 12 inches per minute.



Velan Publication *VEL-PS*

Prevention of Center Cavity Overpressurization & *Thermal Binding*

SUMMARY

- Prevention or elimination of center cavity overpressurization and/or thermal binding are key considerations in power plant operation.
- All valves with two seats are subject to CCOP and/or pressure locking
- There are a number of methods to guard against CCOP and pressure locking. Choose the most effective for your plant piping system needs.
- It is the Owner's (or designee) responsibility to identify the potential for CCOP and thermal binding.
- Because of design features, parallel slide valves are not subject to thermal binding.

- **Thank-you……..**

WEIR POWER & INDUSTRIAL