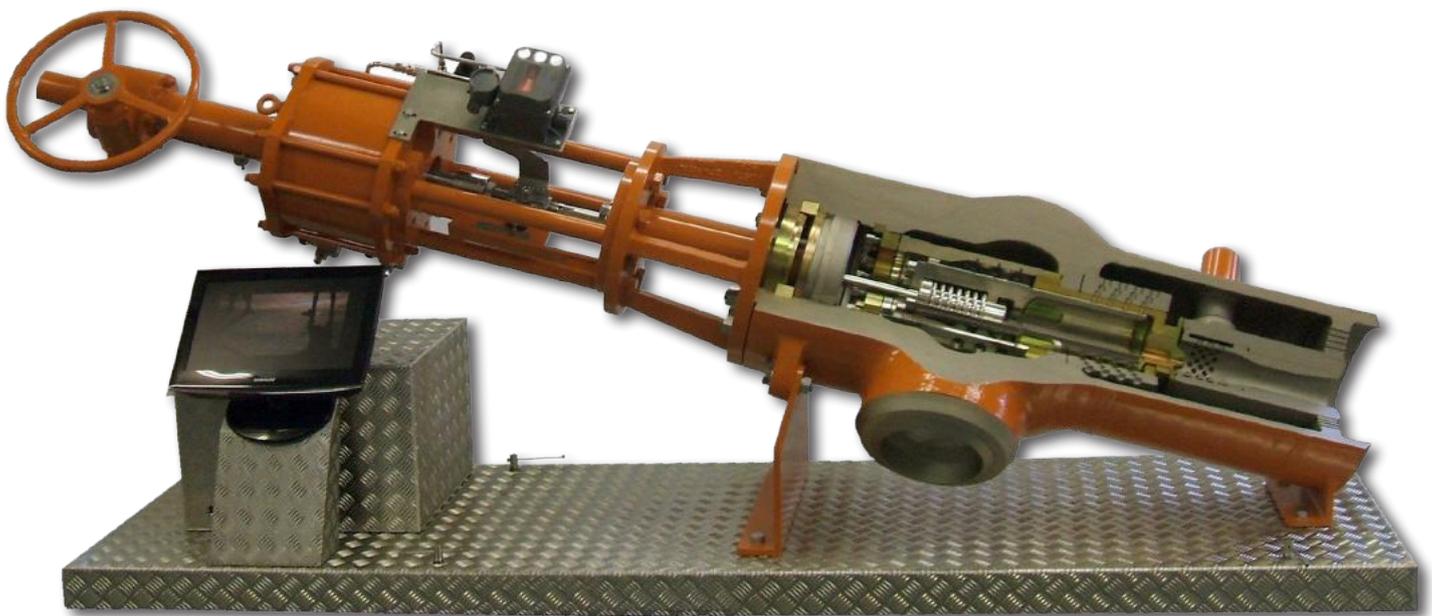


Direct Steam Conditioning Valve – Steam Atomising

DSCV - SA



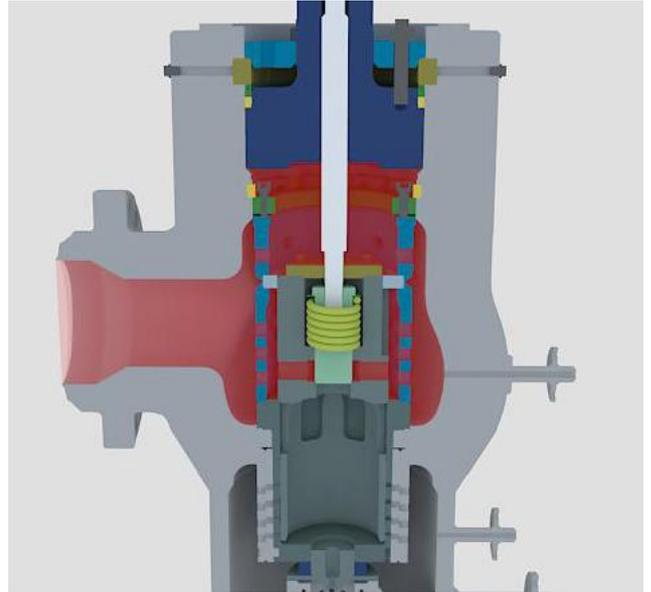
SPX - An introduction

The DSCV-SA is a world leading steam conditioning valve specifically designed for the most arduous applications such as steam turbine bypass systems, either open or closed cycle, continuous steam letdown stations and CHP plants. These valves form a critical part of the safe and efficient operation of all power stations and steam distribution systems.

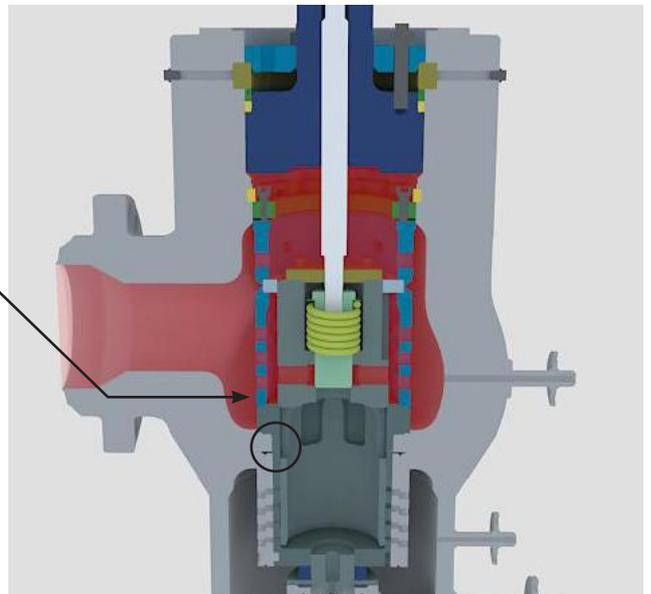
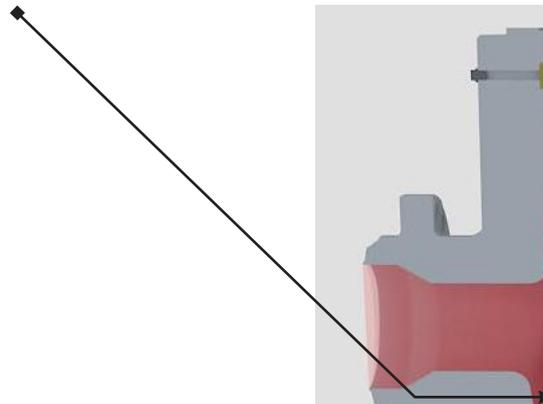
The Copes-Vulcan DSCV-SA valve has evolved over many years to be at the forefront of today's thermodynamic engineering in steam conditioning. The following highlights the key features that these valves must satisfy and how the DSCV-SA has been designed to specifically address the demands of these application and its end users.



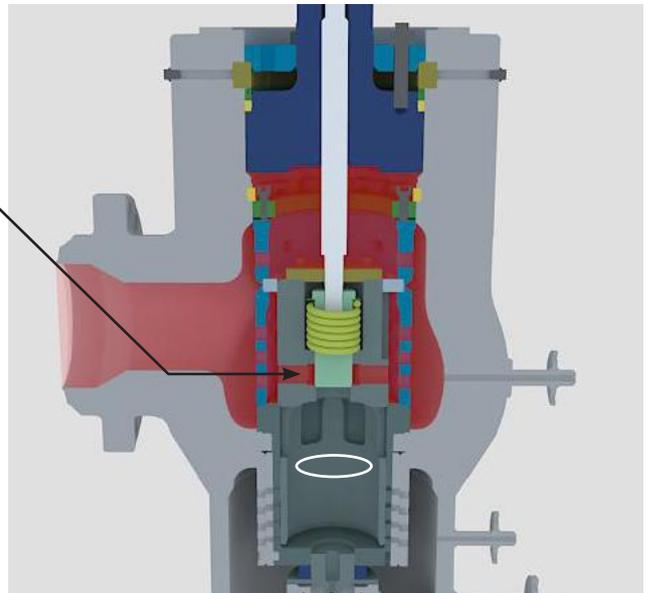
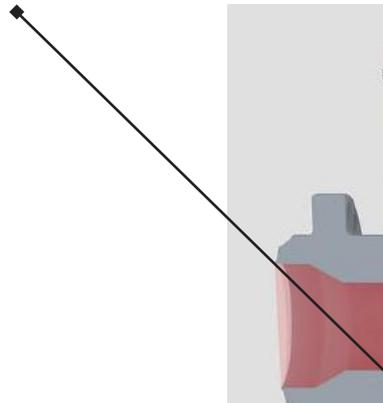
THE DSCV-SA VALVE HERE IS IN THE CLOSED POSITION



THE MAIN PLUG IS FULLY SEATED

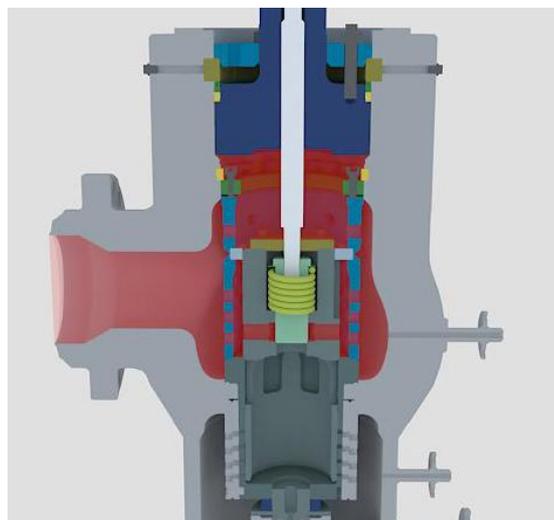


AND THE PILOT TANDEM PLUG IS CLOSED



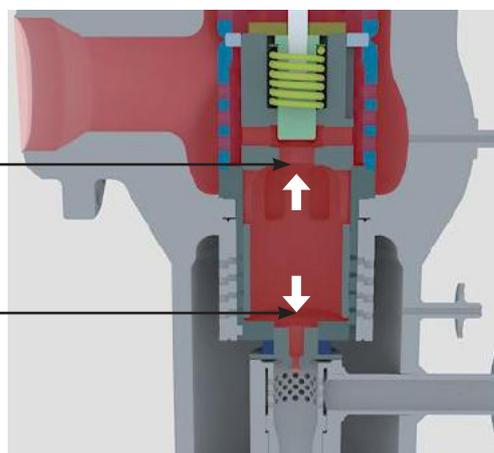
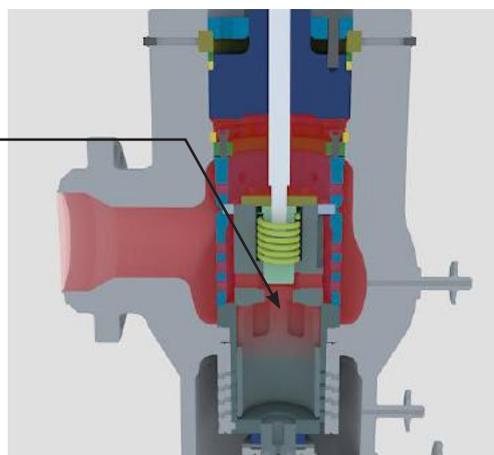
The DSCV-SA valve has a very tight shut off in the closed position, as a minimum ANSI FCI 70-2 class V. It achieves this tight shut off by utilising a pilot plug design so that in the closed position the main plug is unbalanced with the full steam pressure acting on the top of the plug, this load combined with the actuator thrust resulting in very high seat contact loads, which ensures a very tight shut off.

Not only is tight shut off required for plant thermal efficiency it also prevents leak induced 'wire drawing' damage across the seat which would otherwise result in frequent maintenance to repair or replace the seat.



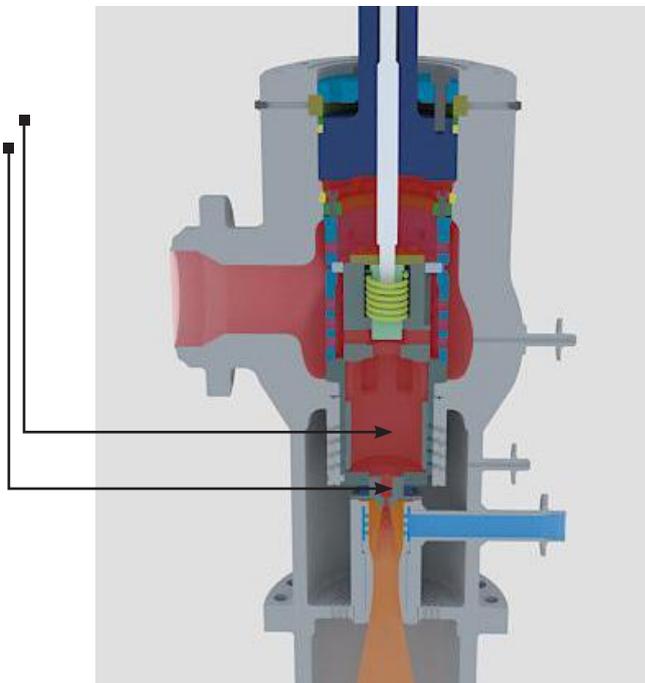
When an open command signal is received, the actuator retracts and the pilot plug is the first to open. This allows P1 steam to flood through the large pilot plug port to the underside of the main plug. The main plug is now balanced reducing the actuation thrusts required.

As can be seen, the CV or capacity of the pilot port is several times greater than the atomising nozzle and designed leak paths of the cage guiding system ensuring equal inlet pressure on the underside and top side of the main plug.

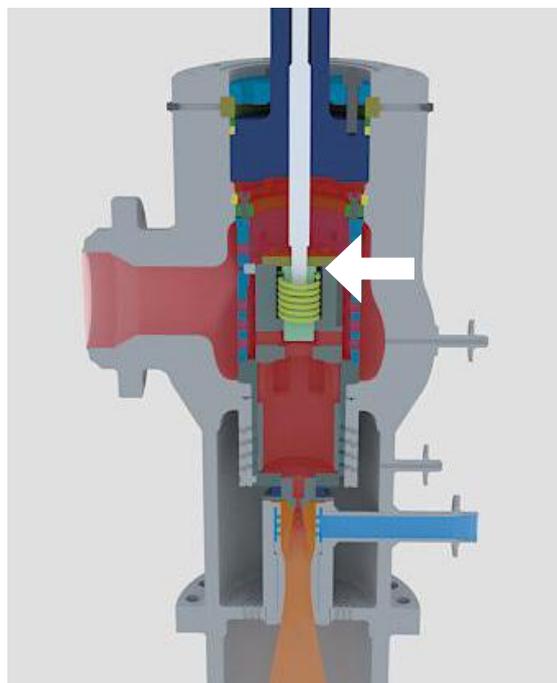


High pressure balancing or P1 balancing is a key design feature of the DSCV-SA for reliable smooth operation. Some other designs employ low pressure or P2 balancing however these low pressure balancing systems rely on auxiliary balancing seals such as piston rings and close tolerance sealing surfaces to prevent the high pressure steam unbalancing the trim. In operation if these seals or surfaces wear or become damaged the trim quickly becomes unbalanced stem loads dramatically increase and fluctuate which can result in the valve oscillating violently or even unable to open on command.

Now with the pilot plug open, high pressure inlet steam has flooded the underside of the main plug and the steam atomising unit is now operating in preparation to receive the incoming cooling water from the water control valve

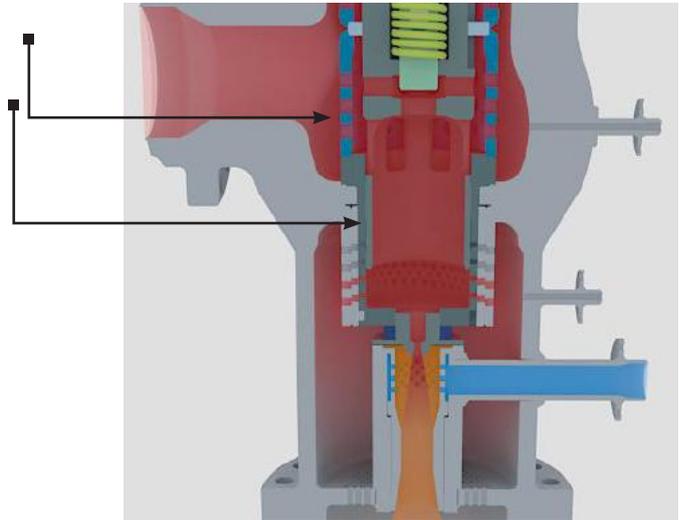


The pilot plug shoulder has now engaged with the underside of the tandem cap of the main plug. The main plug now starts to lift and the main seat opens



As the main plug opens, steam first enters the valve via a heavy duty distribution spacer. The steam passes through the spacer by means of numerous holes evenly positioned around the full diameter

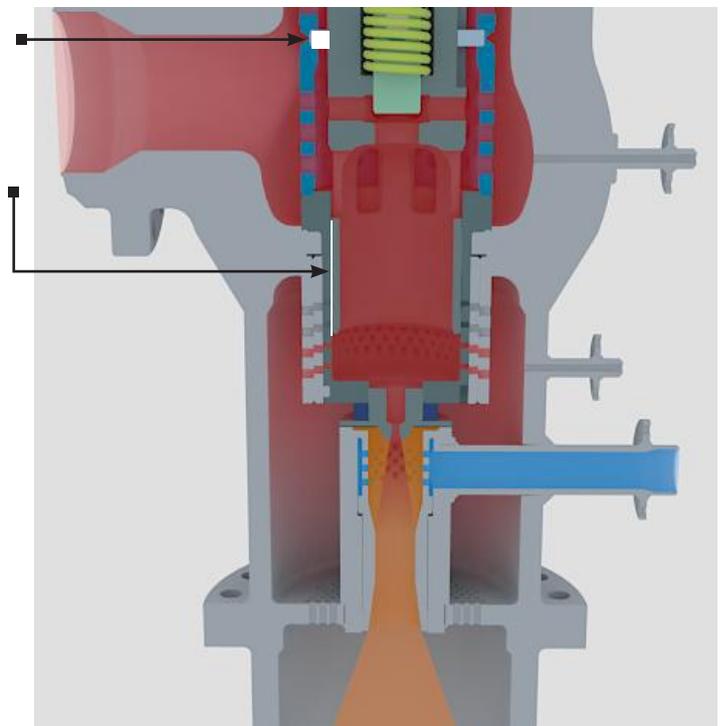
This heavy duty distribution spacer has been specifically designed to negate any upstream pipework induced flow disturbance being communicated to the main plug. Therefore long radius bends or isolation valves can be fitted directly to the valve inlet to minimise installation space. The main plug is fully guided by the cage and spacer to ensure complete plug stability through full travel.



The main plug is fully and securely guided throughout. The upper section of the main plug is guided in a specially hardened and extremely robust guide ring with an integral anti-rotation key.

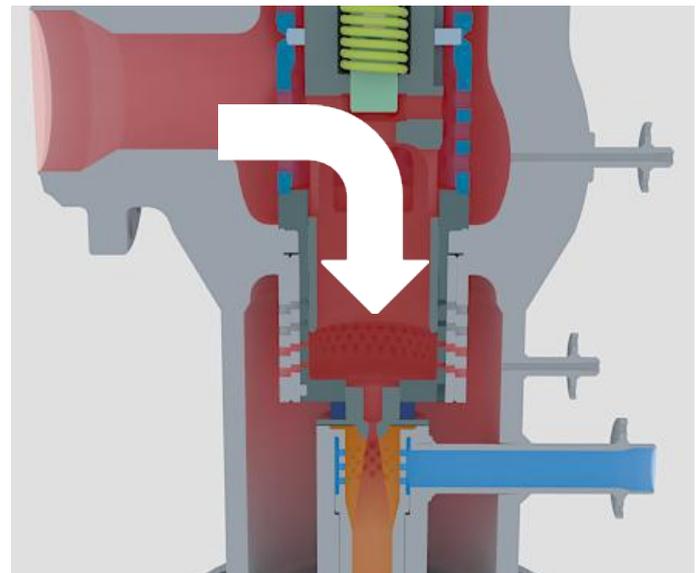
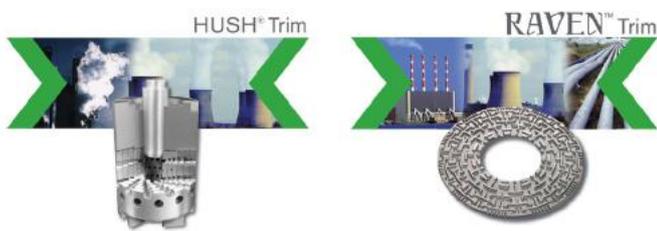
The lower section is securely cage guided through its entire length.

The combination of the heavy duty inlet distribution spacer and full cage guiding ensure total plug stability even in the most arduous installations.

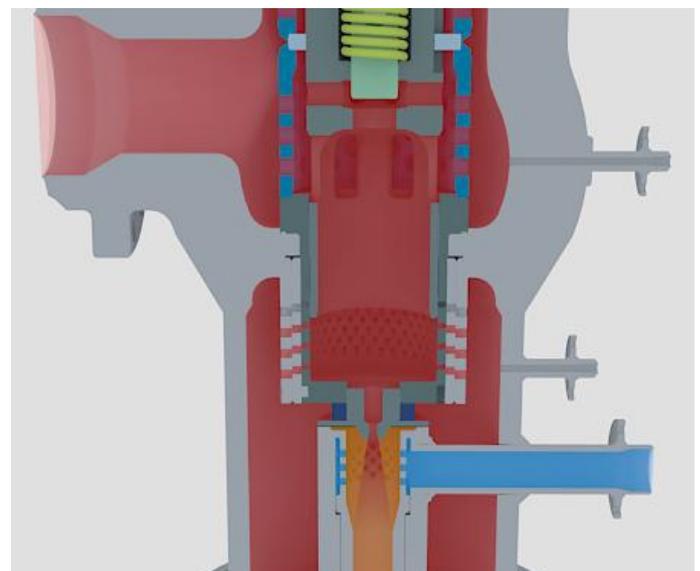


After the inlet steam has passed through the distribution spacer it now travels through the main seat area to the underside of the main plug via large feed ports

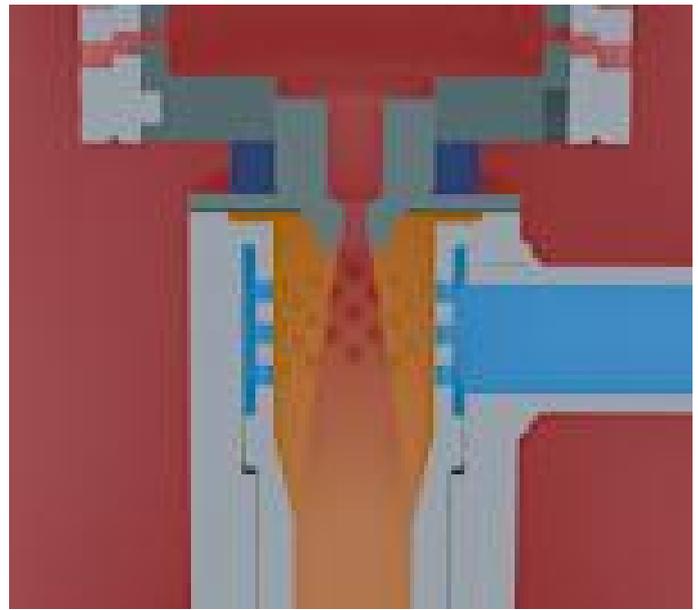
With the main plug now lifted the pressure reducing ports of the cage are now open to allow the steam to be pressure reduced in a controlled manner. As the command signal increases and the actuator further opens the main plug further pressure reducing ports are exposed and the steam flow rate increases. Copes-Vulcan can supply the DSCV-SA steam turbine bypass valve with its industry proven active noise attenuation trim styles, Single and Multi stage HUSH or the multi labyrinth, multi disk RAVEN



The pressure reduced steam exits the cage into the outlet section of the steam bypass valve. If an outlet diffuser is fitted the steam pressure in this area is slightly higher than the final downstream pressure. This final pressure drop is taken across the outlet diffuser. The outlet steam guide or diffuser have several functions; they align the steam that has exited the pressure reducing cage providing a perfect mixing zone for the introduction of the cooling water. they also provide a very secure anchor point for the steam atomising head. The outlet steam guide or diffuser forging can also be used as a material transition point to eliminate on-site dissimilar welding, as the bypass valve is an ideal point which piping engineers can utilise to change piping class and material.

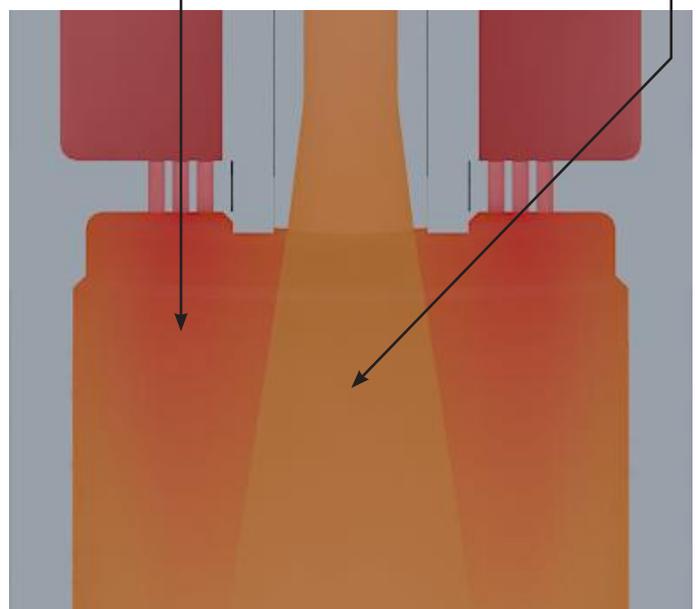


The cooling water enters the DSCV-SA directly into the steam atomising head. The cooling water is forced into an annular chamber which is created by a multi holed combining tube. The combining tube uniformly directs the cooling water into the atomising zone. The energy available in the high pressure steam is efficiently converted into a high velocity expanding jet of steam. The cooling water is instantaneously atomised and travels forward into the venturi section of the atomising head. Here the steam and finely atomised cooling water decelerate and expand as heat is transferred from the atomising steam into the cooling water. As the water is not being "sprayed" into the steam via mechanical nozzles then the water pressure at the water connection of the DSCV-SA need only to be equal to the downstream steam pressure. This allows for low pressure condensate extraction water to be used rather than expensive boiler feed water.



This intimately mixed fluid exits the venturi section with the consistency of a 'hot fog'. As the cooling water is finely atomised and pre-heated the final desuperheating takes place directly after the outlet diffuser section.

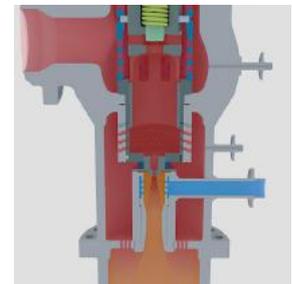
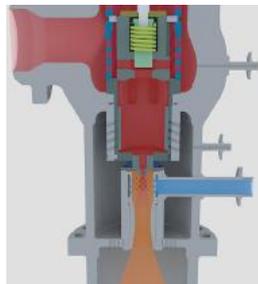
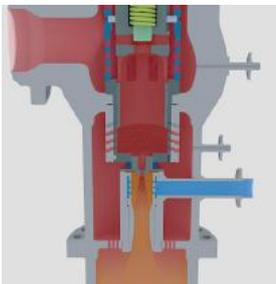
With the outlet stream guide or diffuser aligning the main steam flow creates an excellent mixing zone the where the final stage of desuperheating occurs rapidly and evenly without danger of thermal shock or water drop out in the downstream pipe work. As final evaporation occurs very quickly then the required downstream straight line lengths are kept to an absolute minimum."



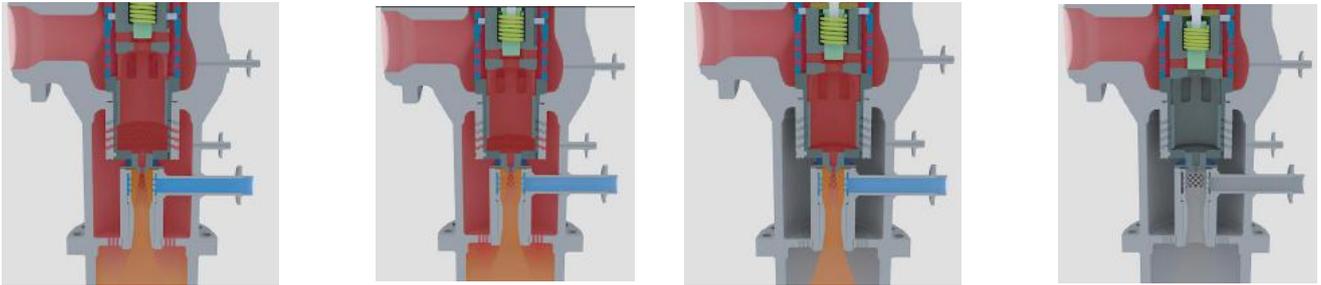
The DSCV-SA valve must be capable of controlling the maximum steam loads but equally important is accurate control and temperature stability at low loads and transition phases. Therefore Turndown or rangeability is an extremely important consideration that plant designers and power generators must consider.

The DSCV-SA was specifically design to achieve extremely high turndowns and wide performance envelopes. This is realised by numerous trim options and the method of cooling water introduction employed, steam atomisation. The trim options of HUSH or RAVEN are characterisable and all have very low minimum controllable CVs. Steam atomisation has several benefits over mechanically spraying the cooling water via nozzles. Mechanical spray nozzles, even spring loaded types are limited in their turndown as the water atomisation and spray pattern degraded as the water flow rate and available pressure differential reduces. As the water demand reduces the spray water control valve closes and the spray valve trim absorbs the water pressure differential leaving little pressure differential for the spray nozzles. This lack of pressure differential at the spray nozzles does not allow them to atomise the spray water, leading to the water pouring into the steam rather than a fine atomised mist. Mechanical spray nozzles also rely on the surrounding steam velocity to provide adequate mixing. When the steam load reduces so does the steam velocity and the ability of mechanical spray nozzles equally reduce. This effect manifests itself with poor downstream steam temperature control and water 'drop-out'. Water drop-out can be very damaging as cold water will track along the bottom of the inside wall of the downstream pipe whilst un-cooled superheated steam travels along the top and sides. This produces high thermal shocks which can lead to steam header fracture.

The DSCV-SA employing steam atomisation for the cooling water introduction has several major benefits. The atomising steam pre-heats the cooling water a significant accelerating the evaporation and desuperheating process. Equally important is to finely atomise the incoming cooling water. Very fine atomisation produces extremely small water droplet sizes with a massively increased surface area to promote rapid heat transfer. The atomised, pre-heated water in introduced into the centre of the steam flow with the finely atomised cooling water being carried by the atomising steam itself and therefore has no dependency on the main steam velocity. Therefore for turndown the DSCV-SA is unrivalled."

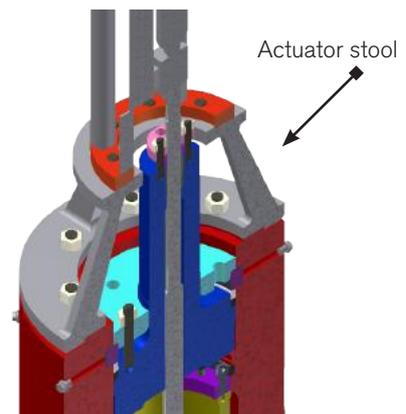


When a closing signal is received the main plug smoothly extends back into the cage which proportionately decreases the steam flow rate.



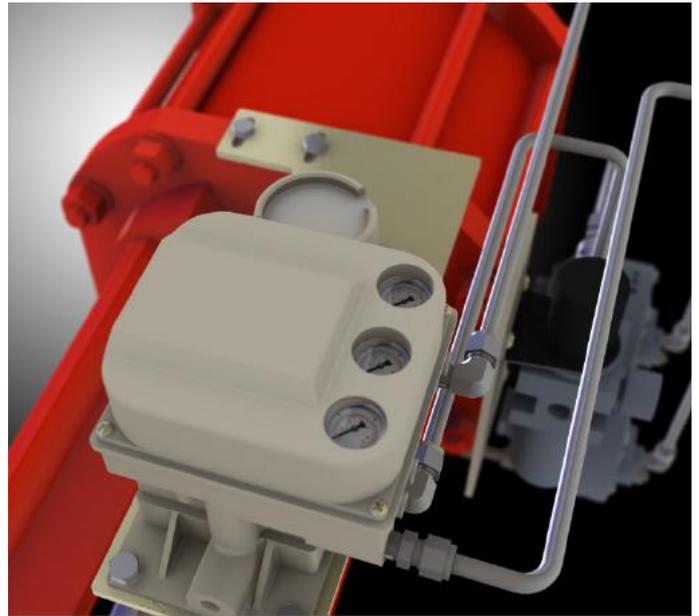
The main plug continues to close until the main seat is engaged. At this point virtually all the steam flow has ceased. The actuator continues to extend until the pilot plug engages with its seat. At this point full inlet steam pressure is applied to the top of the main cage and the underside of the cage decays to downstream pressure. Effectively the trim is now unbalanced. This unbalanced force significantly augments the seat contact load resulting in a very tight and repeatable shut off.

Some systems such as steam turbine bypass, HP header letdown stations, etc. must be able to react and modulate very quickly under emergency conditions such as a turbine trip. Stroking speeds of less than one second may be required. The DSCV-SA can be supplied with either pneumatic or hydraulic actuation to meet this critical requirement. With extremely rapid stroking speeds and large actuation forces it is vital that the actuator and its interface with the steam letdown valve is sufficiently robust to handle these extreme sudden loads. The actuator is connected to the valve by a specially designed actuator load stool.



The stool safely transfers and spreads the actuation loads into the heavy section body of the DSCV-SA and NOT into the valve bonnet thus not compromising the bonnet joint integrity or alignment. The stool is spigoted onto the DSCV-SA body and held in place with high tensile, high temperature bolting.

The DSCV-SA comes equipped with the latest in modern 'SMART' instrumentation to suit all forms of communication protocol, fail safe requirements, responsiveness and accuracy. All plant specific requirements can be met.



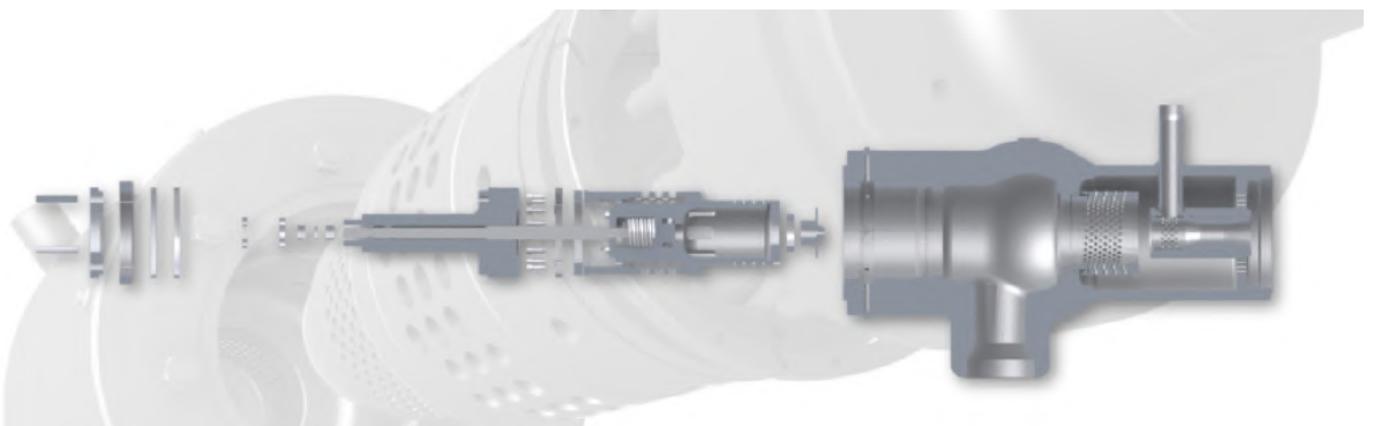
The DSCV-SA can be mounted in the steam header in any orientation allowing full flexibility to the plant piping engineers. All actuators supplied with DSCV-SA steam turbine bypass valves are designed to be self supporting in a horizontal orientation. Therefore no additional supports are required.

As demonstrated earlier upstream and downstream straight line lengths are kept to a minimum with this world leading design.



There are no special tools required for maintenance of the DSCV-SA.

The DSCV-SA is not a high maintenance valve. However the Copes-Vulcan engineering team were tasked with 'easy maintenance' within their design brief. The complete trim is a 'Quick-Change' style with no welded in components or large internal threaded parts. The whole trim assembly is held in compression by either a compression ring or the bonnet. By simply removing the compression ring or bonnet the whole trim simply slides out of the top of the valve. Therefore in-situ maintenance, should it be required, is both expeditious and uncomplicated with no need for any specialised tooling or training.





Direct Steam Conditioning Valve – Steam Atomising

DSCV - SA

