

# Fisher® Steam Conditioning Technologies

Critical Applications, Reliable Solutions



Severe Service



## Industry Trends

In today's marketplace there is an ever-increasing need for steam at specific temperatures and pressures. Significant improvements have been made to increase operational thermal efficiency and heat rates by the precise and coordinated control of the temperature, pressure, and quality of the steam. Most of the steam produced in power and process plants today is not at the required conditions for all applications. The sizing, selection, application, and installation of the proper desuperheating or steam conditioning equipment are critical to optimum performance.

### Power Industry

Competing in today's power market requires heavy emphasis on the ability to utilize multiple strategies. Increased cyclical operation, daily start-stop, and faster ramp rates are used to ensure full load operation at daily peak hours to maximize profit and allow for plant availability.

Changes resulting from environmental factors and economics are combining to alter the face of power production worldwide. These factors are affecting the operation of existing power plants and the design of future plants. Today's advanced plant designs include requirements for increased operating temperatures and pressures and stringent noise limitations in urban areas.

### Hydrocarbon and Petrochemical Industries

Hydrocarbon and petrochemical industries rely on the economical conversion of low cost feedstock to higher profit products. These products are created through the use of process units that perform the operations required.

Hydrocrackers, furnaces, distillation columns, reactors, and other process units must be designed to meet a wide range of conditions to accommodate various modes of plant operation. Temperature is a critical factor taken into consideration during the design of each process unit and must be precisely controlled to optimize each operation, directly impacting the bottom line.

Temperature is controlled in a variety of ways in a process plant environment. The most common ways to control temperature are through the use of heat exchangers and process steam. Process steam must be conditioned to a point near saturation where it is transformed into a medium that is more efficient for heat transfer. Properly selected equipment will ensure optimum plant availability, reliability, and profitability.

### Additional Industries

Other process industries such as mining, pulp and paper, life sciences, and food and beverage experience reliability issues caused by steam conditioning challenges. These industries also use steam for motive force and heat transfer.

Emerson not only offers a wide breadth of Fisher® technologies designed to handle the most severe steam conditioning applications, but also offers service capabilities—from project conception through the life of your plant. By utilizing local application experts and experienced design engineers, Emerson Process Management can deliver custom solutions for your specialized steam conditioning needs.

## Science of Steam Conditioning

Both in the process and power industries, steam is used to perform mechanical work and to serve as a heat transfer fluid. Unfortunately, both functions are accomplished best with steam properties at opposite ends of a spectrum—dry superheated steam is best for mechanical work, while desuperheated steam near its saturation point is better for heat transfer. Going from the high end of the spectrum to the low end involves steam conditioning.

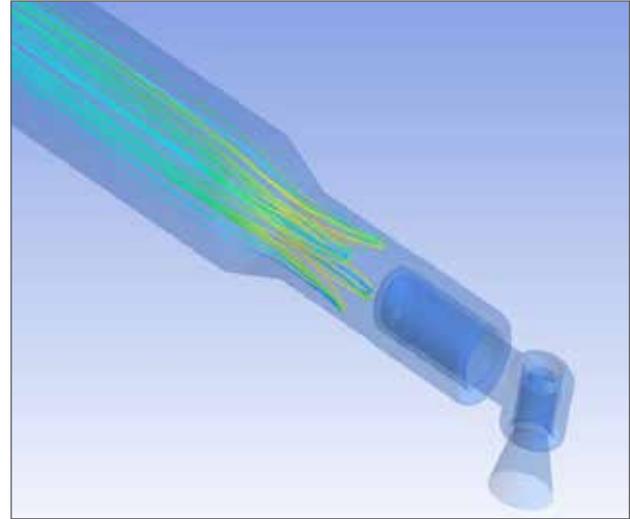
What complicates steam conditioning is temperature control or desuperheating. This seemingly simple practice of adding water to steam to lower its temperature is actually quite complex because desuperheating leads to a temporary, two-stage, liquid-vapor flow with potential control difficulties.

### Why Desuperheat?

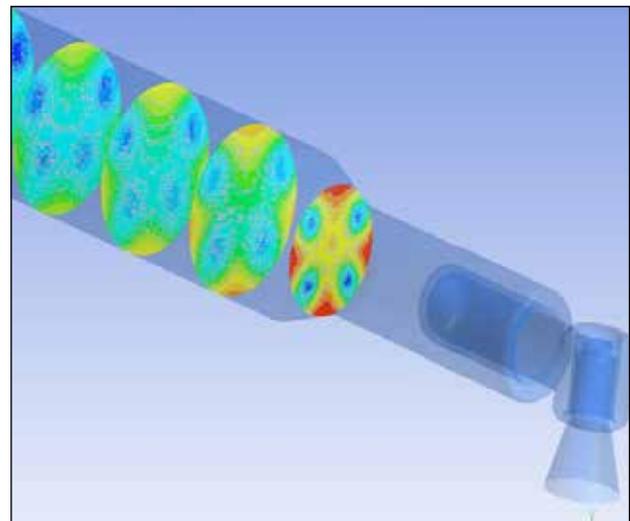
Desuperheating or attemperation as it is sometimes called, is most often used to:

- Improve thermal efficiency of heat transfer processes by using steam near saturation
- Control unintentional superheat from pressure reduction of the steam
- Protect downstream equipment and piping from elevated temperatures and pressures

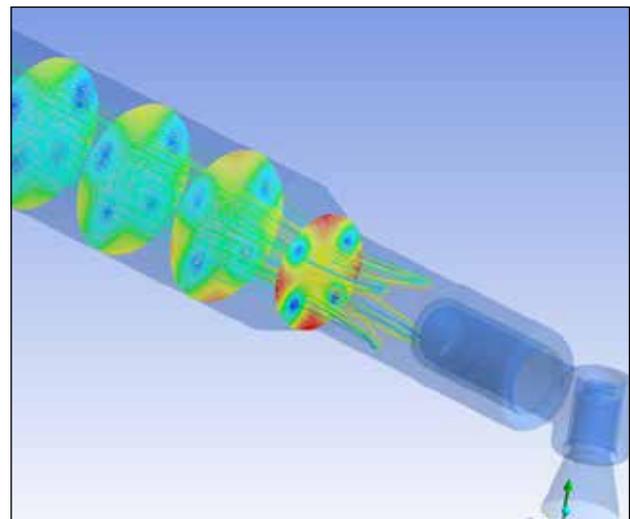
The goal of desuperheating is to reduce the temperature setpoint at the shortest possible piping distance and elapsed time while avoiding damage from two-phase flow. A number of critical installation and application parameters influence whether or not this goal is reached.



*Injection models used for desuperheating water injections into downstream steam. Selected streams are colored by temperature.*



*Radial planes show the downstream temperature. Notice the cooling water effect a few pipe diameters downstream of the water injections.*



*Composite image illustrates the combination of water temperature effect on steam/water mixture downstream of pressure reduction portion of the control valve.*

## Critical Application and Installation Parameters

### Temperature Setpoint

Improper injection of spraywater, especially in larger pipelines, can result in an uneven distribution of the steam's temperature. This causes not only a false temperature reading of the steam saturation, but also a cycling of the desuperheating system.

### Spraywater Temperature

The temperature of the spraywater is critical to rapid vaporization and conversion into steam. As a rule, water is deemed hot at approximately 180 °F (82 °C) and greater. The higher above 180 °F (82 °C), the better the atomization exiting each spray nozzle. Potential flashing issues exist both in the spraywater control valve and across the nozzles. Flashing of the spraywater as it exits the nozzle is beneficial. However, flashing upstream, in either the control valve or just before the nozzle, drastically inhibits performance and may damage both pieces of equipment.

### Initial and Final Steam Superheat

The initial amount of superheat reduction needed is determined by the amount of spraywater flow. The greater the amount of spraywater, the longer it takes for complete vaporization. Equally important is the converse: the desired amount of final superheat. Controlling to a setpoint barely above saturation makes the vaporization process more difficult.

### Spraywater Pressure

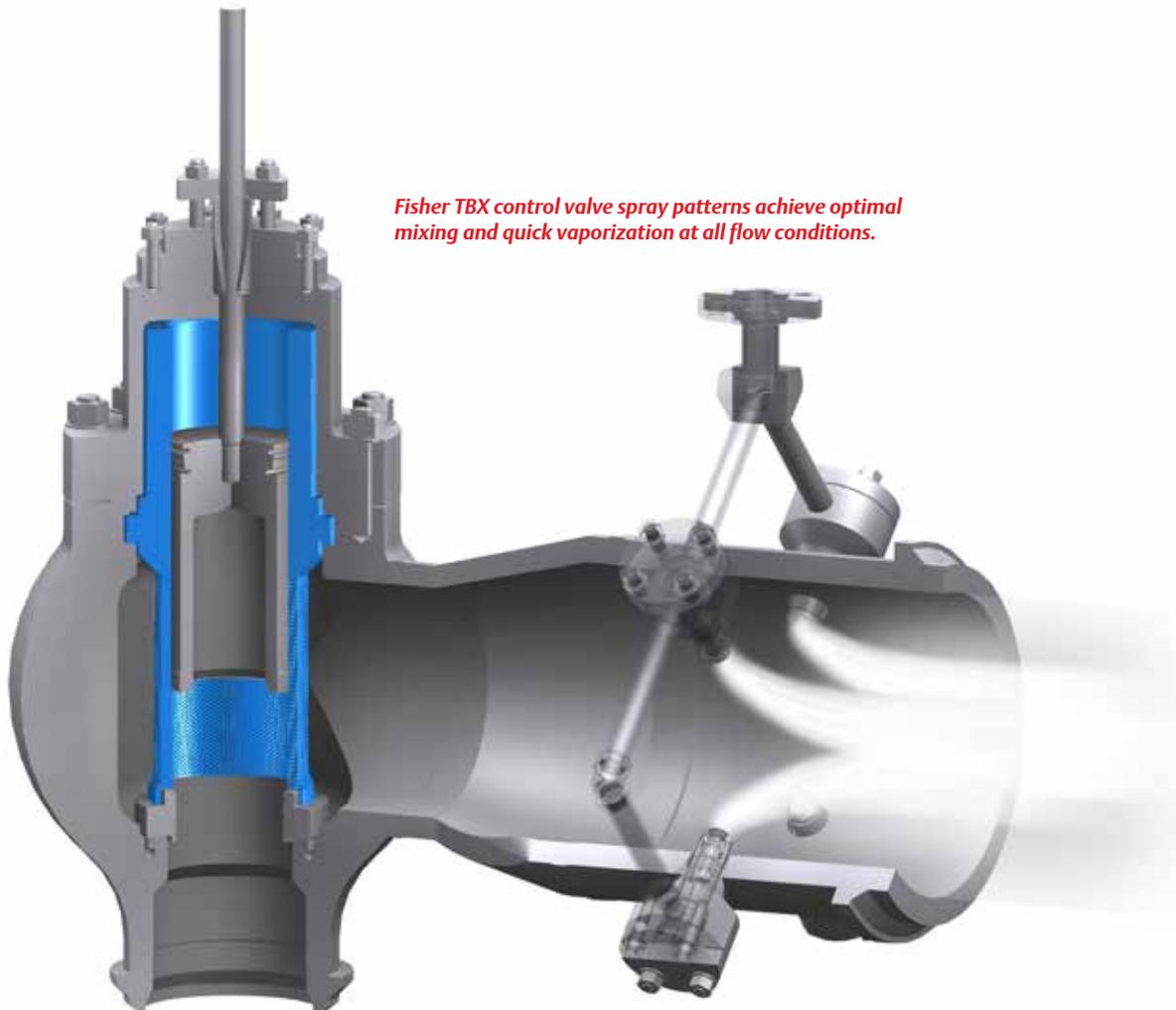
The amount of pressure differential between the spraywater and steam is important for both water atomization and rangeability between maximum and minimum water flows. Although desuperheating devices can operate at much lower differentials, a direct correlation exists between differentials and vaporization speed performance as well as the ability to obtain controllable low-flow levels.

### Minimum Steam Velocity

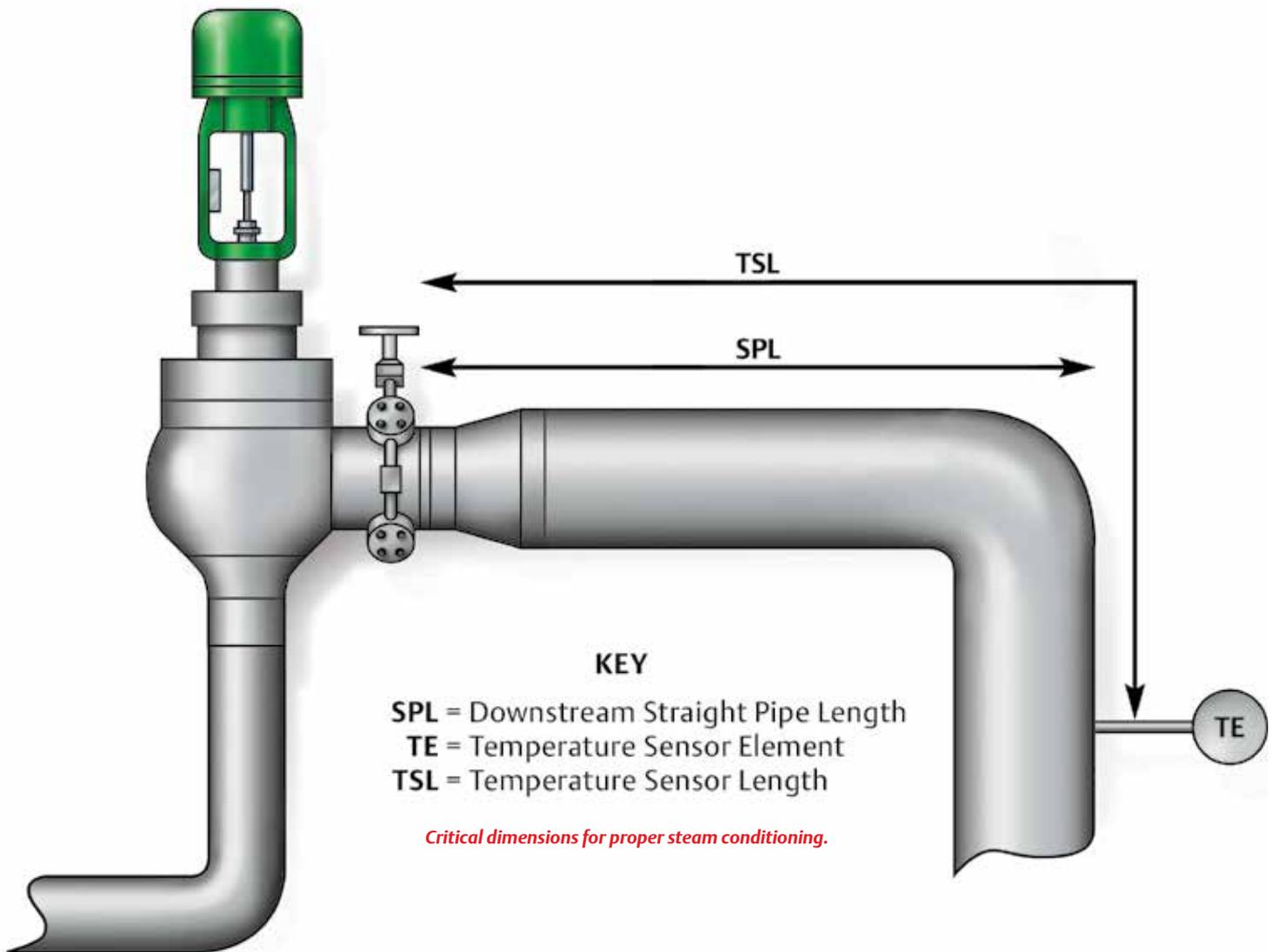
One of the most critical aspects of water vaporization involves minimum steam velocity. For vaporization to occur, water droplets must remain suspended in the steam flow until they can completely evaporate. Water fallout may occur if operating at very low steam velocity levels, which may cause damage to downstream piping and equipment and affect the ability to reach the desired temperature setpoint.

### Maximum Steam Velocity

The higher the velocity, the faster two-phase flow moves in the pipe and the greater the distance required to completely vaporize the spray water into steam. High velocity may be beneficial because its greater overall turbulence enhances mixing. Most steam piping velocity guidelines suggest a maximum velocity of 200 feet (61 m) to 250 feet (76 m) per second to minimize turbulence-induced vibration.



*Fisher TBX control valve spray patterns achieve optimal mixing and quick vaporization at all flow conditions.*



### Pipeline Size

Excess amounts of spraywater in pipelines can lead to water impingement on the pipe wall and fallout. Conditioning steam in large pipelines can be challenging because establishing a homogeneous mixture of steam and injected water is difficult. This may lead to inaccurate temperature measurements and poor temperature control.

### Downstream Straight Pipe Length

If straight downstream pipe length is insufficient, non-vaporized water droplets will contact the first elbow pipe wall and fall out of the steam. This unevaporated water will lessen the effect of the injected spraywater resulting in higher temperatures and requiring the addition of more water. This will lead to additional spraywater falling out of suspension. Furthermore, the portion of the elbow pipe wall hit by the spraywater will erode.

### Steam Pipe Liner

Liners are used to protect the steam pipes against water impingement and thermal shock where spraywater is injected. If spraywater comes in contact with liners, the potential for serious damage exists. Careful consideration of installation factors can replace the need for such a device. However, when no alternative is available and the potential for spraywater fallout is great, a liner can protect against cracking of the main pressure-retaining pipe.

## Critical Application and Installation Parameters

### Installation Orientation and Accessibility

Orientation of the desuperheater can affect the speed of vaporization. Installations where spraywater is injected into a horizontal pipe are most common. Installations in a vertical flow-up pipe perform slightly better because of the positive effect gravity has on the injected water droplets—a longer residence time enhances vaporization. Installations in a vertical flow-down pipe perform less efficiently than horizontal configuration because of the negative effect of gravity—reducing residence time. Industry practices vary and all installation orientations can be successful if the system is properly designed.



*Case-in-point: The Fisher AF nozzle was clogged by particulate when a proper strainer was not used.*

### Turndown

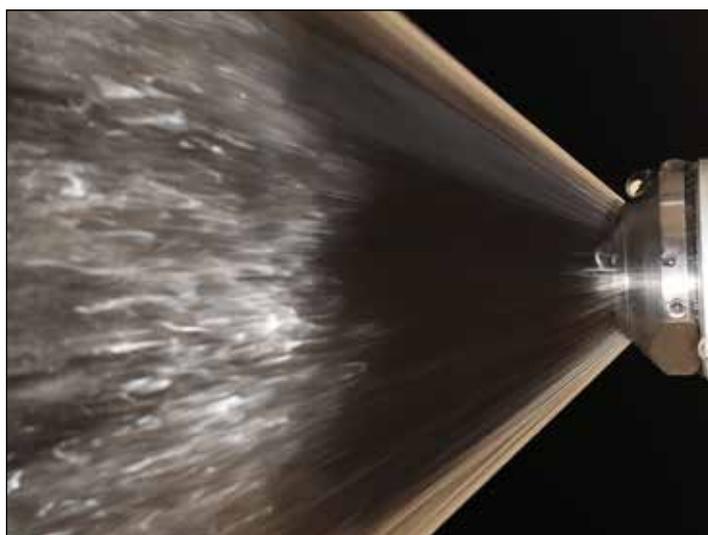
When considering turndown, it is critical to recognize variations in both steam and spraywater pressures, temperatures, and flows that occur at various operating times. The driving consideration for temperature control is the nozzle's ability to create an adequately formed conical-shaped spray pattern. That pattern must be comprised of droplet size and shape easily converted and maintained over a range of conditions. The spray nozzle's ability to perform defines the range between controllable maximum and minimum spraywater flow.

### Strainers

Without the use of strainers, the spray nozzles can become clogged by debris, which can decrease capacity as well as distort the spray pattern. Use of strainers upstream of the spraywater control valve is always recommended to ensure optimum unit performance, efficiency, and reliability.



*Spray pattern of a damaged mechanically atomized spray nozzle.*



*Spray pattern of a working mechanically atomized Fisher spray nozzle.*

## Damaging Effects of Steam Conditioning

### Excessive Noise and Vibration

Noise is a concern for plant operators and maintenance personnel. Noise not only causes excessive sound pollution but also causes equipment damage, vibration, and control valve body and trim erosion. Steam conditioning is the process of combining a pressure reducing valve in conjunction with a desuperheater. Typical steam conditioning applications involve high pressure drops. Where there are high pressure drops there is potential for noise and vibration issues.

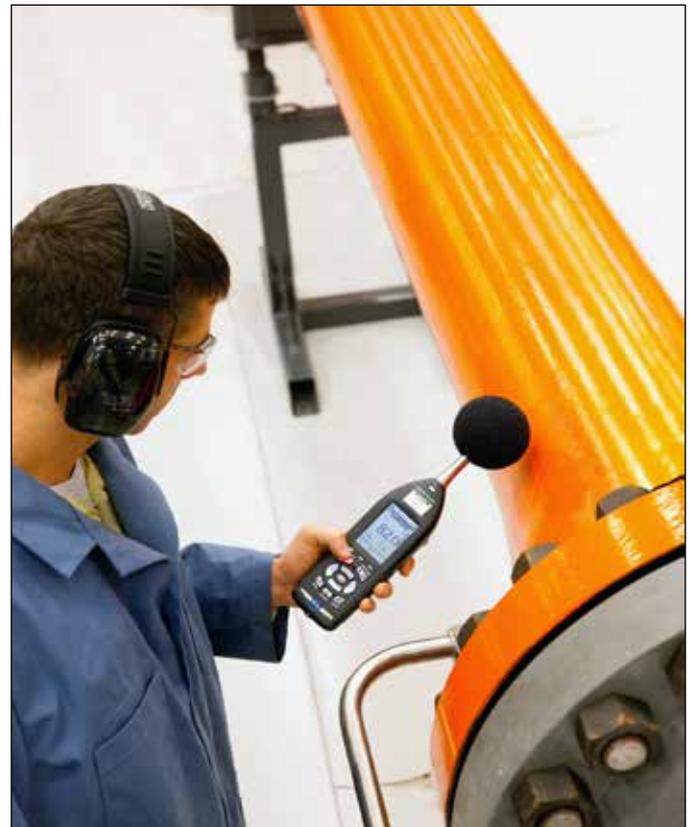
All power or process steam plants, whether traditional coal fired, integrated gasification combined cycle, nuclear, or combined cycle, have the potential to experience noise and its related effects. This is due to the turbulence and vibration experienced in applications such as turbine bypass systems, steam venting, and sootblower systems.



*The Fisher TBX control valve with noise abatement trim helps prevent issues associated with noise and vibration.*

Populated areas are moving closer and closer to industrial facilities and noise attenuation is crucial to avoid complaints and potential regulatory action. More importantly, excessive noise levels can cause health concerns to plant personnel.

Heavy vibration can cause trim, actuator, and accessory failures, cracked pipes and welds, and/or structural damage. If not properly addressed, these damaging effects may ultimately lead to expensive maintenance and trim repair, unplanned shutdowns, loss of productivity, and loss of profitability.



*A wide range of Fisher noise attenuation control technologies are available for a variety of steam conditioning applications.*

## Damaging Effects of Steam Conditioning

### Flow Accelerated Corrosion

Many materials achieve their corrosion resistance through the development of a “passive layer” on the surface. Most common are the corrosion resistant materials containing chromium and/or molybdenum. In these alloys, the chromium and/or molybdenum will combine with oxygen at the surface to form a tough, adherent oxide layer that is resistant to attack in many environments. Under high-velocity conditions, such as seen in many steam conditioning applications, this passive layer is “washed off” the surface, allowing the material to corrode, a phenomenon called “erosion-corrosion.”

In control valves, Flow Accelerated Corrosion (FAC) problems are exhibited in a variety of ways. Over time, the damage caused by FAC may directly result in control valve bodies and piping components rusting and washing away. Other times, damage caused by FAC is an indirect result of magnetite build-up from boiler tubes and/or other plant equipment, resulting in trim and sealing surface damage.

Generally, FAC can be controlled by changing the materials of construction to those that are more corrosion resistant and compatible with the fluid. An example of this would be replacing a carbon steel body with chrome-moly or stainless steel. Other times, changes to the control valve design may produce the best result.

### Leakage While Closed

In spraywater control valves, leakage occurring during shutdown conditions can cause large amounts of water to be leaked, creating puddles in low-lying areas of the piping. If not properly drained, these puddles can be picked up as slugs and end up in the steam lines causing major damage to downstream piping and equipment. Flow accelerated corrosion can also occur, resulting in damage to downstream piping components.

If seat leakage occurs when a steam conditioning control valve is closed, the fluid moves quickly from a high-pressure area to a low-pressure area, which may result in potential steam cuts and damage to the plug tip and seat ring. In a power plant, the effects of this damage can be loss of megawatts, expensive trim repair, unplanned shutdowns or downtime, and loss of production. In a process facility, the effects of this excess leakage may cause lost efficiencies in downstream operating equipment.



*Damage to the control valve plug caused by steam leakage while closed.*

# Steam Conditioning Equipment Control Strategies

Pressure control design is standard in steam conditioning, seldom encounters any problems, and is always a closed loop feedback system. The process variable can be either the upstream or downstream pressure, depending on the application.

The temperature control strategy can be either feedback or feedforward depending on external factors and application requirements.



## Feedback Temperature Control

A closed loop feedback temperature control system is used when there is an accurate and consistent method for temperature measurement. By definition, the system is dependent on detecting a deviation in setpoint and feeding this information back to the control system to initiate final control element adjustment. The primary factor that can adversely influence the accuracy of this type of system in steam conditioning is the presence of water in the steam. In many instances, especially in heat transfer applications, there is a need for controlling the steam temperature as close to saturation as possible. The inherent problem with this is that the closer the temperature gets to saturation, the more likely the steam flow will have residual water droplets. This is due to the fact that the temperature profile of a steam flow is uneven, often with cooler temperatures in the center and progressively hotter temperatures moving outwards. Therefore, it is important to not control too close to the point of saturation, with an optimum target setpoint of 15 °F (-9 °C) to 20 °F (-6 °C) above saturation. As a minimum, the setpoint should not be less than 10 °F (-12 °C) above the steam saturation point.

## Feedforward Temperature Control

A feedforward control system is one that responds to input variables and makes preempted or anticipated adjustments to the final control element to maintain the desired setpoint.

Feedforward temperature control needs to be used when either the operating conditions allow the use of a control valve designed with intrinsic feedforward proportioning, or when there is no accurate temperature measurement available.

These two situations are:

### 1. Feedforward Control With Intrinsically Designed Valves

These style control valves allow for automatic proportioning of water flow to steam flow. They are best suited for those applications in which the steam flow is variable and the inlet and outlet pressures remain constant.

### 2. Feedforward Control When Outlet Temperature Measurement is Impractical

An external feedforward control strategy is used when it is not possible to get accurate temperature measurement using normal feedback control techniques, when control performance requires more responsiveness, or when the control variables are changing in a disproportionate manner. Such control is available via the use of an external logic controlling device, e.g. PLC or DCS, and incorporating a control algorithm to determine the appropriate system response to achieve the desired outlet temperature.

## Steam Conditioning Equipment Selection

Steam conditioning equipment can come in many different forms from simple desuperheaters to much more complicated equipment that integrally incorporates steam pressure and temperature control functions into one control device. This equipment addresses the need for better control of steam condition brought on by increased energy costs and more rigorous plant operation. Steam conditioning equipment also provides better temperature control, improved noise abatement, and requires fewer piping and installation restrictions than the equivalent desuperheater and pressure reduction station. Steam conditioning control valve designs can vary considerably, as do the applications they are required to handle. Each has particular characteristics or options that yield efficient customer specified requirements. Selection should be done based on specific process conditions and desired plant outcomes. No one-size fits all device exists.

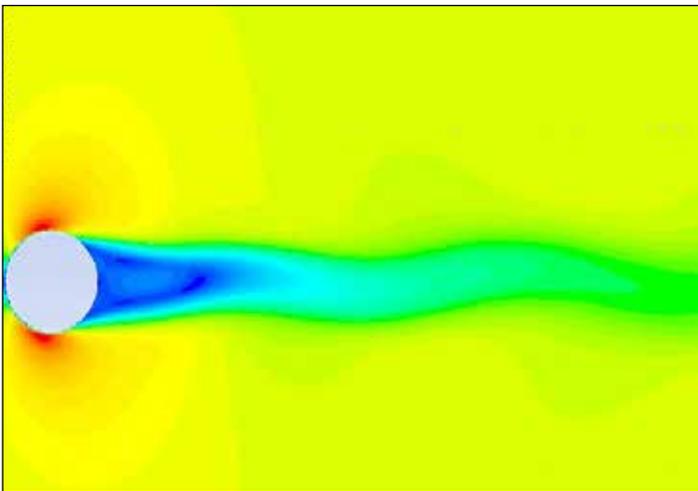
### Desuperheating

The need to desuperheat is usually performed to control the steam temperature or heat content of the flowing vapor media. Depending on the process downstream of the main steam source, a desuperheater will be utilized to transform the steam into a medium that is more efficient for heat transfer or more conducive for interaction with its surrounding components. One means of accomplishing this is with a direct contact heat transfer mechanism. This can be achieved by the use of a single spray injection nozzle that, when properly placed, diffuses a calculated quantity of liquid into the turbulent flow stream. Vaporization of the liquid phase proceeds while mass, momentum, and energy transfer occurs and the resultant vapor exits the process at the desired temperature or heat content level.

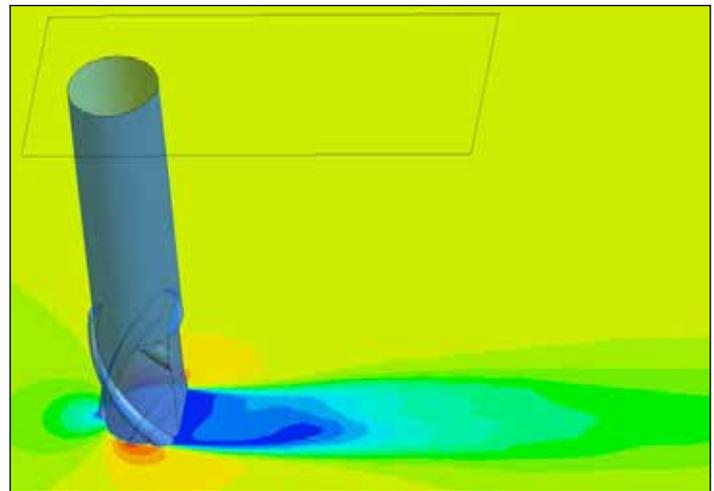
### Desuperheaters

A desuperheater is a device that injects a controlled amount of cooling water into a superheated steam flow in an effort to reduce or control steam temperature. Desuperheaters come in various physical configurations and spray types that optimize performance within specified control and installation parameters. Selection should also always include attention to those details that would provide the most economic solution without sacrificing required performance.

The success of a particular desuperheater station can depend on a number of physical, thermal, and geometric factors. Some factors are quite obvious while others are more obscure. All have a varying impact on the performance of the equipment and the overall system. Considerable research has and continues to be conducted into the characteristics of desuperheaters and the transformation of spraywater to vapor.



*2-D image using Computational Fluid Dynamics showing sinusoidal velocity profile downstream of circular cross-section insertion style desuperheater. This profile is acceptable for low velocity applications.*



*3-D image using Computational Fluid Dynamics showing a non-sinusoidal velocity profile downstream of enhanced insertion style desuperheater technology. This enhanced design improves fatigue resistance in high velocity applications by disrupting coincident vortices formed by flow around the device.*

Selection of the correct style of desuperheater is important for each respective application. Units come in all shapes and sizes and use various energy transfer and mechanical techniques to achieve the desired performance criteria. These design criteria include:

- Mechanically atomized—fixed and variable geometry spray orifice
- Geometrically enhanced
- Externally energized

The mechanically atomized style of desuperheaters is the most popular and simple style. It provides nominal performance over a wide range of flow and conditions. These models are of internally energized variety. The atomization and injection of the spraywater is initiated by the pressure differential between the spraywater and the steam. The simplest of nozzle designs have a constant area flow path. These units are highly dependent on the pressure differential and thus provide levels of performance that are commensurate with the magnitude of the difference. The larger the water or steam pressure differential, the better the unit will perform. A typical turndown is usually limited to 4:1 and therefore is best suited for near steady load applications.

A higher tiered design to the fixed geometry spray orifice is a variable geometry nozzle desuperheater. The actual flow geometry of the unit is varied to maintain an optimum differential across the discharge orifice. As a result of this change, the level of flow variation is greatly enhanced as is the performance. Equipment turndowns can reach 10:1 making this style a good choice for medium change applications. This unit can be used in conjunction with an external control valve.

Another form of mechanically atomized desuperheater is a geometrically enhanced style desuperheater. This design supplies a high pressure recovery flow restriction that alters flow geometry and helps to keep the level of turbulence and kinetic energy at a high level during all phases of the unit's operation due to an increased velocity at the point of spraywater injection. This increased level of surrounding energy helps to impart energy transfer to the droplets and assists in break-up, mixing, and vaporization. This style is best suited for medium turndown applications typically around 15:1.

The last form of desuperheater units utilizes an external energy source for the atomization of the spraywater. The most common medium is a high pressure steam source. In this case, the high levels of kinetic energy are provided by a critical pressure reduction in the desuperheater sprayhead. The critical drop is used to abate and shear the water into a fine mist of small droplets, which is ideal for vaporization. This type of system can provide a very high degree of flow variation without requiring a high pressure water supply. Applications requiring turndown ranges greater than 40:1 may utilize this type of equipment for best performance. In addition to an external spraywater control valve, the system will also require an atomizing steam shutoff valve.



*Fisher TBX-T ring style desuperheater with optional liner.*

## Steam Conditioning Equipment Selection

### Control Valve Selection

Selecting a steam conditioning control valve for this complex process should first be done by understanding the performance goals that need to be accomplished, what real piping geometry exists or is planned, and determining what process controls are needed. Once this is understood, incorporate factors such as control valve style and size, pressure and flow control needs, noise specification requirements, material requirements, and operational practices of the process. Many variations are possible and range from separate globe bodies with downstream desuperheaters to all-in-one devices that incorporate pressure and temperature control in one unit.

Separate globe or angle valve bodies with downstream desuperheating devices can be selected that conveniently fit into the piping layouts already in place. Sliding stem control valves are designed to provide precise flow control. They also can incorporate noise abatement trims that are often needed for the large pressure drops seen in steam letdown and turbine bypass applications. This approach can accommodate mild to severe application ranges.

When the applications become extremely severe, use of a steam conditioning control valve that combines pressure and temperature control in a single device is recommended. Optimizing the control valve's operating performance and overall reliability are key to preventing unplanned shutdowns and lost production. Rugged designs capable of handling full mainstream pressure drops while incorporating noise abatement technology prevent the generation of excessive noise and vibration.

Control valve trim configurations require the ability to accommodate rapid changes in temperature, as experienced during a turbine trip. Cages necessitate the use of casehardened materials for maximum life while allowing expansion during thermally induced excursions. Essential to the control valve plug is the use of cobalt-based overlays both for continuous guiding and to provide long lasting tight, metal-to-metal shutoff.

Manifolds should feature variable geometry, back-pressure activated nozzles that maximize mixing and quick vaporization of the spraywater. Nozzles must be sized to prevent the spraywater from flashing prior to exiting the nozzle as this significantly changes flow characteristics and capacity of the associated nozzle at a critical point in the operation.

Spraywater should be injected radially towards the center of the pipeline into the high turbulence of the axial steam flow and away from the pipe wall. The number of injection points will vary by application. In high steam pressure drop applications, the outlet size of the control valve increases drastically to accommodate the larger specific volumes. Correspondingly, an increased number of nozzles are arranged around the circumference of the outlet, making for a more even and complete distribution of the spraywater.



*Separate Fisher globe valve cooler, and all-in-one units are available to fit piping configurations.*

## Actuation

In typical bypass systems, it has been common practice to trip the TBS valves to a preset opening corresponding to a predetermined flow rate demand during a plant event. However the valves had to be left in manual for a specific amount of time until the systems stabilized before they could switch over to automatic operation. This requires specialized algorithms and control logic that increases operation complexity which up until a few year ago was unavoidable.

However in today's power market, the limits of turbine bypass systems are being pushed. Instead of having to worry about putting the TBS valves in manual during a plant event, installations are using high performance actuation to respond with both fast and precise control to meet various plant demands. Turbine bypass valves must be responsive in order to protect critical and costly turbines from damage during transients. They also must be accurate to allow operation at peak efficiency.

An understanding of the stroking speed and control requirements may necessitate complex actuation packages designed to meet the requirements of the process. Typically, times of of 2-4 seconds are required to move the valve position to anywhere 85-100% travel from any position. Precision actuation technology is required to not only trip this valve quickly but do so with better than 1% positioning accuracy for even very large control valves.

Setup and tuning should be accomplished within minutes with the capability of doing so remotely being highly desirable. On the software side, this is done through software packages that provide for tuning parameters set specifically for these types of valves. Parameters should be set to improve the response to small amplitude steps by overdriving the set point, asymmetrically adjust the response to set independently in the opening and closing times, and integrate real time graphics to allow for adjustments to be done remotely.

On the hardware side, mechanical cushions should be used to provide controlled deceleration to help protect the actuator and valve components. The components themselves should be linkage less and non-contacting to eliminate the potentiometer and ensure there are no sliding parts to wear. Mounting hardware should be robust in nature and facilitate the capability of remote mounting. Quick exhaust valves should not be used. In place of these components, large volume boosters should be utilized to simplify the actuation package and provide a more compact, robust arrangement.



*Typical Fisher ODV actuation package for use on turbine bypass applications.*

## Materials of Selection

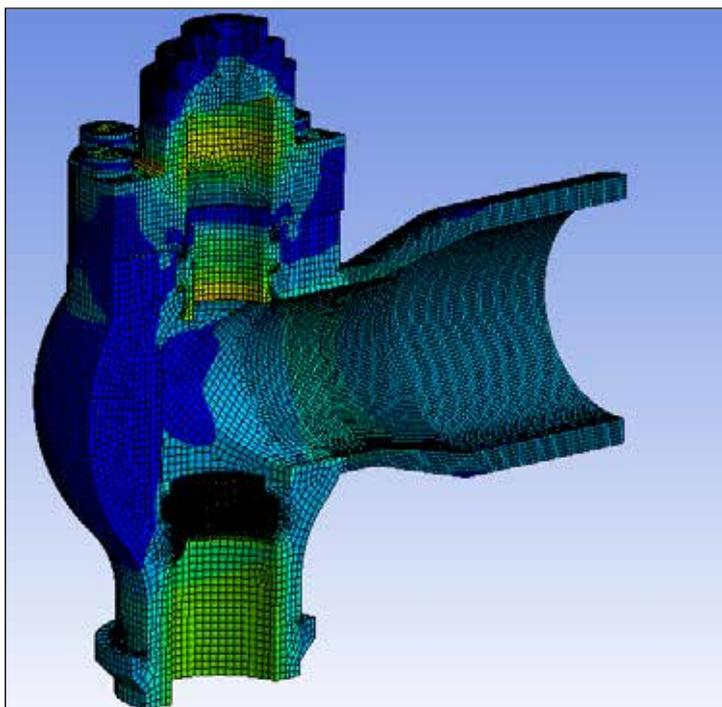
### Trim for High Temperature and Pressure

When higher temperatures and/or pressures are involved, the standard control valve trim combination may not be acceptable due to inadequate yield strength, creep resistance, or sliding wear resistance. A number of Fisher trim material combinations are used for these applications depending upon the control valve style and the actual operating conditions.

### Coefficient of Thermal Expansion

When metallic materials are heated, they expand in a predictable and repeatable manner. Each alloy has its own characteristic thermal expansion coefficient versus temperature curve that can be used to predict its growth as it is heated. In general, related materials have similar thermal expansion properties, and can be grouped for general discussion purposes. The alloy steels and 400 series stainless steels have fairly low thermal expansion coefficients, whereas the 300 series stainless steels have very high expansion rates. The carbon and nickel alloys fall in between.

When selecting materials for a control valve that will be used at elevated temperatures, thermal expansion differences must be taken into account. Differential thermal expansion between plugs and cages can cause binding or excessive looseness at operating temperatures. Likewise, differential thermal expansion in a body-bonnet-cage-seat ring system can cause loss of gasket load, resulting in leakage. Differences in thermal expansion rates must be either eliminated (by selection of like materials) or accounted for (by proper dimensioning of parts) when a control valve is to be used at temperatures significantly above ambient.



*Finite Element Analysis (FEA) technique showing pressure boundary components at elevated temperatures.*

### Alloy Steel Bodies and Bonnets

When higher temperatures and/or pressures are involved, alloy steels are often specified for bodies and bonnets. Metals that contain high amounts of Molybdenum are used for bodies and other pressure retaining parts, most commonly in power plant and oil refinery equipment. Molybdenum is effective for increasing strength at higher temperature, and chromium increases strength and improves oxidation resistance. These materials possess excellent high temperature properties, and resist creep and corrosion at high temperatures. They withstand steam erosion more satisfactorily than carbon steel, and to offer high resistance to impact. Because of the high chromium and molybdenum contents, these materials are air-hardened, and special precautions must be taken during welding.

Grade 91 materials have presented several challenges to the power industry. For maximum service life, recommended hardness of the base material is between 190 HB and 248 HB and the hardness of weld deposits should be between 190 HB and 265 HB. Stringent welding, heat treating, and inspection procedures ensure Fisher control valves are manufactured to the latest industry standards for maximum service life and reliability.

### Dissimilar Metal Welds

It is understood that dissimilar metal welds (DMWs) are a necessary part of modern power plant design. As steam pressures and temperatures decrease, there is great cost benefit to taking advantage of lower grade piping materials as allowed by the conditions of the steam. However, these DMWs require extra attention to ensure a long service life, as these joints have historically been prone to failure in piping systems.

A common failure mode when joining materials with large alloy content differences, such as grade 91 to grade 22, is carbon migration. Carbon migration occurs over time at elevated temperatures from the lower alloy side of the weld to the higher alloy side. This migration can leave the lower alloy side weaker due to the reduced carbon content.

There are few ways to reduce these affects. One approach is to locate the joint in lower stress areas and to design the joint such that unnecessarily elevated stresses local to DMW are avoided.

Where DMW's are required the material transition should occur in the form of a spool piece welded to the end of the valve inlet or outlet. This helps to avoid locating near higher stress regions such as body angle transitions.

## Emerson Innovation

### Fisher® Technology Development

The Emerson Innovation Center for Fisher Technology in Marshalltown, Iowa, USA, is home to the world's largest flow lab used to evaluate control valves. It incorporates flow testing capabilities up to NPS 36 and 3,500 psig (241 bar). Final control elements are tested in conformance to IEC and ISA standards in real-world plant conditions to ensure production reliability, efficiency, environmental compliance, and safety.

Emerson engineers conduct tests that analyze noise, materials, fatigue, wear, high and low temperatures, control valve actuators, control valve instrumentation, reliability, loop variability, leakage, hydrostatic forces, gaskets, seals, and control system compatibility. In the controlled lab environment, special tests are commonly performed to answer customers' questions.

Process plants require controlled noise levels to protect employees and reduce fence-line noise levels to maintain good relationships with adjacent, populated areas. Fisher noise attenuation technologies enable effective noise-reducing control valves and provide installed predicted noise levels consistently, for compliance with regulatory limits. Supported with a 51,000 ft<sup>2</sup> (4,738 m<sup>2</sup>) facility and a unique 26,000 ft<sup>2</sup> (2,415 m<sup>2</sup>) sound chamber, Emerson can accurately quantify noise from piping and vents. Acoustics expertise is utilized at all stages, from product development to application, quotation, and as-installed performance. Experts are available to analyze the entire plant environment and solve noise problems beyond the control valve.

Minimal stress on all features of a pressure vessel greatly improves fatigue life and therefore, safety. Using advanced FEA models, Emerson engineers analyze complex geometries in control valve designs to locate stress concentrations and incorporate design modifications to minimize stresses.

Turbine bypass valves must be responsive in order to protect critical and costly turbines from damage during transients. They also must be accurate to allow operation at peak efficiency. Technologies incorporated in Fisher turbine bypass valves are unmatched by any other manufacturer. Fisher precision actuation technology enables a full stroke up to 20 inches (50.8 cm) in less than one second and better than 1% positioning accuracy for even very large control valves. Setup and tuning can be performed remotely and in minutes. Without Fisher technology it can take hours. Factory acceptance testing to Fisher product specifications typically eliminate the need for any tuning changes after installation. FIELDVUE™ digital valve controllers use special control and tuning algorithms for robust, stable, high performance control.

High vibration from process plant operation can shorten equipment service life, damage critical components, and cause deterioration or total loss of control. Fisher control valves are designed and tested for robustness in vibration applications. Emerson engineers qualify products to industry vibration standards and then go farther. For instance, Fisher products are subjected to additional testing for millions of cycles at their resonant (worst case) frequency to assure performance in your power and process plants. Fisher steam conditioning equipment, by design, is enhanced to improve vibration robustness.



## Serving You for The Life of Your Plant



For over 35 years Emerson has been a provider of premium service for valves and instruments. Backed by hundreds of people and locations, highly skilled technicians focus on local customer needs and stand ready to support the following aspects of the life cycle management of new or existing steam conditioning and turbine bypass systems.

### Startup and Commissioning

One of the most critical aspects of the lifecycle of any steam conditioning or turbine bypass system is the proper installation and startup of your new equipment. Emerson can help support this process through the staging of the valve trim during hydro testing, blowdown and startup, and supervision of the installation and operating trim. Emerson has the expertise to calibrate and tune the positioner and accessories to as-built factory specifications to ensure that the system operates to correspond with your plant dynamics.

### On-Site Servicing and Repair

Facilities are located near customers and can provide local support when needed. All technicians are factory trained in the most current industry standards and the more stringent technologies required for Fisher products.

### In-Line Machining

Many components internal to any steam conditioning or turbine system are welded to the body to provide the integrity and performance demanded. Emerson is fully equipped with the right tools and has the expertise to perform any operation needed to restore equipment back to OEM specification.

### Outage Management

As a professional service provider, Emerson has the tools, equipment, and procedures to provide a professionally planned and executed outage. The proven six step process begins at early engagement and scope planning through execution and post-outage review.

### Equipment Upgrade Modifications

Emerson is continually innovating sealing technologies and performance upgrades. Existing products can be field modified or upgraded so customers can stay up-to-date with the latest technologies available.

### OEM Replacement Parts

The Emerson manufacturing network supports Fisher parts needs in any emergency.

## TBX Steam Conditioning Control Valve (Flow Up)

is designed to handle the most severe applications in today's cycling power plants as well as provide precise pressure and temperature control for process applications. The TBX valve incorporates over 30 years of steam conditioning experience and product development. Finite Element Analysis and Computational Fluid Dynamic techniques are used to optimize performance and reliability for demanding steam systems. The TBX valve design provides the ultimate combination of performance and maintainability.

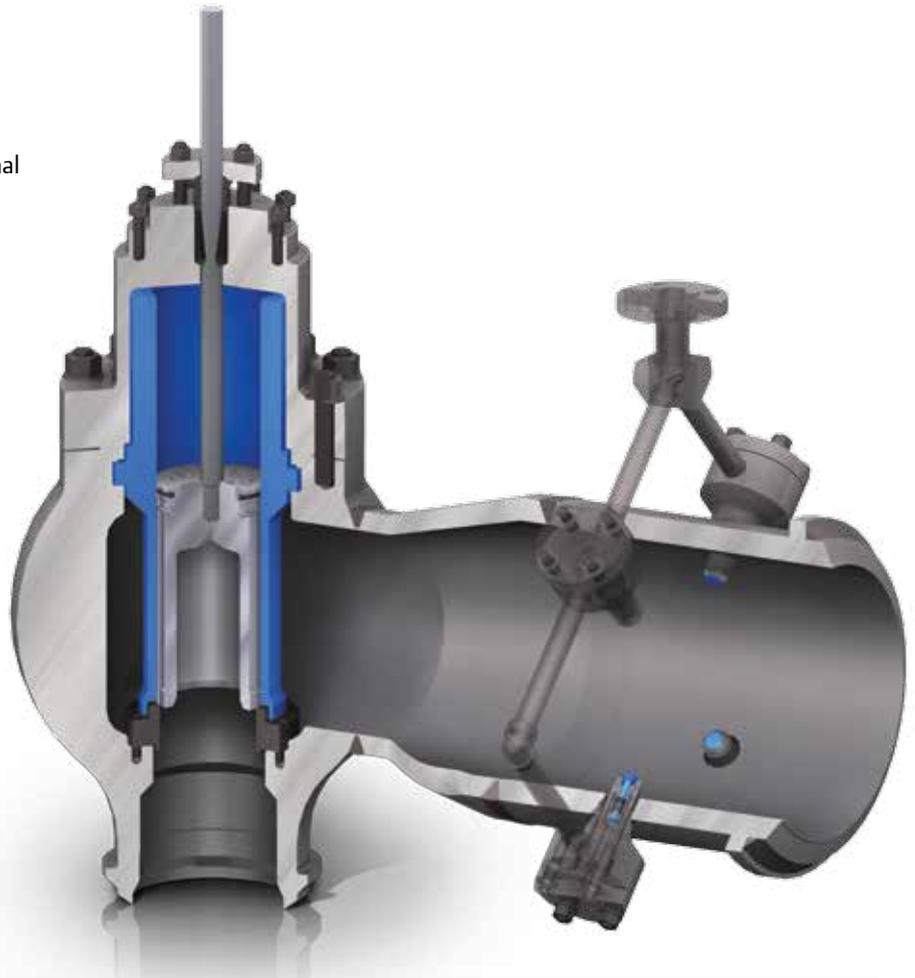
Fisher Whisper Trim™ technology is in all TBX valves and reduces noise across all process conditions. The simplified trim configuration is thermally compensated to handle rapid changes in temperatures, as expected during startup, shutdown, transients or a turbine trip, without any sticking or binding.

### POWER APPLICATIONS

- HP Turbine Bypass
- IP/HRH Turbine Bypass
- LP Turbine Bypass

### PROCESS APPLICATIONS

- MP Steam Letdown
- HP Steam Letdown
- Export Steam
- MP Steam to Distribution
- Main Steam Bypass
- Turbine Bypass



APPLICATION CHALLENGES	PROVEN FISHER® SOLUTIONS
■ Long-term, tight shutoff required	■ Patented Bore Seal technology provides Class V shutoff with its unique balance seal technology.
■ Thermal cycling	■ Thermally compensated trim allows for growth during startups, shutdowns, transients, and turbine trips.
■ Accurate temperature control near saturation	■ Strategically placed variable geometry AF nozzles produce an optimized spray pattern over a wide operating range to achieve optimal mixing and quick vaporization at all flowing conditions.
■ High noise and vibration	■ Whisper Trim technology reduces noise levels by 30–40 dBA across the entire range of process conditions.
■ High pressure drops	■ Full pressure drop capabilities are provided by use of rugged cage design.
■ Costly maintenance and short turnarounds	■ Repairable or replaceable seat ring design options provide long lasting Class V shutoff.
■ Quick response and accurate control	■ High performance pneumatic piston actuators with FIELDVUE digital valve controller can achieve full stroke in less than two seconds while maintaining accurate step response.
■ Piping configuration dictates stem orientation	■ The TBX steam conditioning control valve is available with both flow up and flow down configurations.

## TBX Steam Conditioning Control Valve (Flow Down)

is designed to handle the most severe applications in today’s cycling power plants as well as provide precise pressure and temperature control for process applications. The TBX valve incorporates over 30 years of steam conditioning experience and product development. Finite Element Analysis and Computational Fluid Dynamic techniques are used to optimize performance and reliability for demanding steam systems. The TBX valve design provides the ultimate combination of performance and maintainability.

Fisher Whisper Trim™ technology is in all TBX valves and reduces noise across all process conditions. The simplified trim configuration is thermally compensated to handle rapid changes in temperatures, as expected during startup, shutdown, transients or a turbine trip, without any sticking or binding.

### POWER APPLICATIONS

- HP Turbine Bypass
- IP/HRH Turbine Bypass
- LP Turbine Bypass

### PROCESS APPLICATIONS

- MP Steam Letdown
- HP Steam Letdown
- Export Steam
- MP Steam to Distribution
- Main Steam Bypass
- Turbine Bypass



APPLICATION CHALLENGES	PROVEN FISHER® SOLUTIONS
■ Long-term, tight shutoff required	■ Patented Bore Seal technology provides Class V shutoff with its unique balance seal technology.
■ Thermal cycling	■ Thermally compensated trim allows for growth during startups, shutdowns, transients, and turbine trips.
■ Accurate temperature control near saturation	■ Strategically placed variable geometry AF nozzles produce an optimized spray pattern over a wide operating range to achieve optimal mixing and quick vaporization at all flowing conditions.
■ High noise and vibration	■ Whisper Trim technology reduces noise levels by 30–40 dBA across the entire range of process conditions.
■ High pressure drops	■ Full pressure drop capabilities are provided by use of rugged cage design.
■ Costly maintenance and short turnarounds	■ Repairable or replaceable seat ring design options provide long lasting Class V shutoff.
■ Quick response and accurate control	■ High performance pneumatic piston actuators with FIELDVUE digital valve controller can achieve full stroke in less than two seconds while maintaining accurate step response.
■ Piping configuration dictates stem orientation	■ The TBX steam conditioning control valve is available with both flow up and flow down configurations.

# CVX Steam Conditioning Control Valve

is designed to handle the moderate to severe applications in today's cycling power plants as well as provide precise pressure and temperature control for process applications. The CVX valve incorporates over 30 years of steam conditioning experience and product development. The valve body is designed with the latest FEA and CFD tools to optimize performance and reliability for demanding steam systems. The CVX valve design provides an exceptional combination of performance and maintainability.

Fisher diffuser technology is available in all CVX valves to reduce noise levels. The simplified trim configuration is thermally compensated to handle rapid changes in temperatures expected during startup, shutdown, transients, or a turbine trip, without any sticking or binding.

### POWER APPLICATIONS

- IP/HRH Turbine Bypass
- LP Turbine Bypass

### PROCESS APPLICATIONS

- MP Steam Letdown
- HP Steam Letdown
- Export Steam
- MP Steam to Distribution
- Main Steam Bypass
- Turbine Bypass



APPLICATION CHALLENGES	PROVEN FISHER® SOLUTIONS
■ Long-term, tight shutoff required	■ Patented Bore Seal technology provides Class V shutoff with its unique balance seal technology.
■ Thermal cycling	■ Thermally compensated trim allows for growth during startups, shutdowns, transients, and turbine trips.
■ Accurate temperature control near saturation	■ Strategically placed variable geometry AF nozzles produce an optimized spray pattern over a wide operating range to achieve optimal mixing and quick vaporization at all flowing conditions.
■ High noise and vibration	■ The CVX steam conditioning control valve incorporates Fisher diffuser technology to reduce noise and vibration.
■ High pressure drops	■ Full pressure drop capabilities are provided by use of rugged cage design.
■ Costly maintenance and short turnaround	■ Repairable or replaceable seat ring design options provide long lasting Class V shutoff.
■ Quick response and accurate control	■ High performance pneumatic piston actuators with FIELDVUE digital valve controllers can achieve full stroke in less than two seconds while maintaining accurate step response.
■ Difficult diffuser repair and replacement	■ Optional seat ring diffuser is replaceable while the valve is in the line. It is optimally spaced to prevent spraywater impingement.

## Globe Valve with Desuperheater

can be the most economical choice for low to medium pressure applications. For smaller pipe or lower pressure applications or installations that require horizontal orientation, it is advantageous to separate the pressure reducing valve (PRV) portion from the desuperheating portion. This can be accomplished by using one of many different Fisher globe valve configurations close coupled or completely separated with a desuperheating device. The globe valve can incorporate noise abatement or diffuser technology. The separate desuperheating device can then be located wherever is convenient within the piping configuration and be either an insertion style or ring style desuperheating unit.

### POWER APPLICATIONS

- IP/HRH Turbine Bypass
- LP Turbine Bypass

### PROCESS APPLICATIONS

- MP Steam Letdown
- HP Steam Letdown
- Export Steam
- MP Steam to Distribution
- Main Steam Bypass
- Turbine Bypass



APPLICATION CHALLENGES	PROVEN FISHER® SOLUTIONS
<ul style="list-style-type: none"> <li>■ Long-term, tight shutoff required</li> </ul>	<ul style="list-style-type: none"> <li>■ Patented Bore Seal technology provides Class V shutoff with its unique balance seal technology.</li> </ul>
<ul style="list-style-type: none"> <li>■ Accurate temperature control near saturation</li> </ul>	<ul style="list-style-type: none"> <li>■ DMA, DMA/AF, DMA/AF-HTC, DSA, DVI, and TBX-T desuperheaters can be used in many applications to efficiently reduce the temperature of superheated steam to the desired setpoint. Available variations are mechanically atomized (both fixed geometry and variable geometry) and steam assisted.</li> </ul>
<ul style="list-style-type: none"> <li>■ High noise and vibration</li> </ul>	<ul style="list-style-type: none"> <li>■ easy-e™ and HP series control valves are available with Whisper Trim technology to reduce noise levels by 30–40 dBA across the entire range of process conditions. Where applicable, these control valves may also utilize Fisher diffuser technology.</li> </ul>
<ul style="list-style-type: none"> <li>■ Costly maintenance and short turnaround</li> </ul>	<ul style="list-style-type: none"> <li>■ Trim can easily be interchanged while the valve remains in the pipeline.</li> </ul>
<ul style="list-style-type: none"> <li>■ Quick response and accurate control</li> </ul>	<ul style="list-style-type: none"> <li>■ High performance pneumatic piston actuators with FIELDVUE digital valve controllers can achieve full stroke while maintaining accurate step response.</li> </ul>
<ul style="list-style-type: none"> <li>■ Piping configuration limits face-to-face availability</li> </ul>	<ul style="list-style-type: none"> <li>■ Globe or angle valves can be placed wherever is convenient to accomplish pressure reduction. Separate desuperheater units can be close-coupled or placed downstream at another location.</li> </ul>

## TBX-T Ring-Style Desuperheater

incorporates a spraywater manifold with variable geometry AF nozzles that produce an optimized spray pattern over a wide operating range. Nozzles are strategically placed to achieve optimal mixing and quick vaporization at all flowing conditions. The TBX-T desuperheater can be configured with a PRV immediately upstream, with an integral diffuser, liner, or as a stand-alone device.

### POWER APPLICATIONS

- HP/RH Attenuator Spray
- HRSG Interstage Desuperheating
- HRSG Final Stage Desuperheating
- Auxiliary Steam

### PROCESS APPLICATIONS

- Pressure Letdown Station
- HP to LP Letdown
- Export Steam Letdown
- MP Steam Desuperheater
- Auxiliary Steam



APPLICATION CHALLENGES	PROVEN FISHER® SOLUTIONS
<ul style="list-style-type: none"> <li>■ Accurate temperature control near saturation</li> </ul>	<ul style="list-style-type: none"> <li>■ Strategically placed variable geometry AF nozzles produce an optimized spray pattern over a wide operating range to achieve optimal mixing and quick vaporization at all flowing conditions.</li> </ul>
<ul style="list-style-type: none"> <li>■ Costly maintenance and short turnarounds</li> </ul>	<ul style="list-style-type: none"> <li>■ Nozzles can be easily removed, maintained, or replaced without having to replace the entire unit.</li> </ul>
<ul style="list-style-type: none"> <li>■ Cracked welds</li> </ul>	<ul style="list-style-type: none"> <li>■ Optional liner can be ordered to protect the hot outer pipe from quenching due to the spraywater being introduced into the process steam.</li> </ul>
<ul style="list-style-type: none"> <li>■ Piping configuration limits face-to-face availability</li> </ul>	<ul style="list-style-type: none"> <li>■ TBX-T desuperheaters can be configured with a PRV immediately upstream, with an integral diffuser, or as a stand-alone device located wherever is convenient in the pipeline.</li> </ul>
<ul style="list-style-type: none"> <li>■ Large temperature change needed</li> </ul>	<ul style="list-style-type: none"> <li>■ Nozzles in multiple configurations capable of providing large amounts of spraywater to cool steam to required temperature.</li> </ul>

## DMA and DMA/AF Desuperheater

The DMA is a simple, mechanically atomized insertion style device with single or multiple, fixed-geometry spray nozzles that is intended for applications with nearly constant load.

The DMA/AF is a variable-geometry, mechanically atomized, back-pressure-activated insertion style desuperheater with one or multiple spray nozzles. It is designed for applications requiring control over moderate load fluctuations.

### POWER APPLICATIONS

- HP/RH Attenuator Spray
- HRSG Interstage Desuperheating
- Auxiliary Steam

### PROCESS APPLICATIONS

- Pressure Letdown Station
- HP to LP Letdown
- Export Steam Letdown
- Auxiliary Steam



APPLICATION CHALLENGES	PROVEN FISHER® SOLUTIONS
<ul style="list-style-type: none"> <li>■ Accurate temperature control near saturation</li> </ul>	<ul style="list-style-type: none"> <li>■ Optimized spray pattern with optional AF nozzle technology allows for a wide operating range to achieve optimal mixing and quick vaporization at all flowing conditions.</li> </ul>
<ul style="list-style-type: none"> <li>■ Costly maintenance and short turnaround</li> </ul>	<ul style="list-style-type: none"> <li>■ Nozzles can be easily removed, maintained, or replaced without having to replace the entire unit.</li> </ul>
<ul style="list-style-type: none"> <li>■ Piping configuration limits face-to-face availability</li> </ul>	<ul style="list-style-type: none"> <li>■ DMA and DMA/AF desuperheaters can be located wherever is convenient in the pipeline.</li> </ul>
<ul style="list-style-type: none"> <li>■ Moderate temperature change needed</li> </ul>	<ul style="list-style-type: none"> <li>■ Nozzles capable of providing low to moderate amounts of spraywater to cool steam to required temperature.</li> </ul>

## DMA/AF-HTC Desuperheater

is functionally equivalent to the DMA/AF, however it is structurally suited for severe applications where the desuperheater is exposed to high thermal cycling and stress, high steam velocities, and flow induced vibration.

### POWER APPLICATIONS

- HP/RH Attenuator Spray
- HRSG Interstage Desuperheating
- Auxiliary Steam

### PROCESS APPLICATIONS

- Pressure Letdown Station
- HP to LP Letdown
- Export Steam Letdown
- Process Steam Letdown
- Auxiliary Steam



APPLICATION CHALLENGES	PROVEN FISHER® SOLUTIONS
■ Accurate temperature control near saturation	■ Optimized spray pattern with optional AF nozzle technology allows for a wide operating range to achieve optimal mixing and quick vaporization at all flowing conditions.
■ Costly maintenance and short turnarounds	■ Nozzles can be easily removed, maintained, or replaced without having to replace the entire unit.
■ Cracked welds	■ DMA/AF-HTC desuperheater uses a forged construction optimized to move weld joints away from high stress regions.
■ Piping configuration limits face-to-face availability	■ DMA/AF-HTC desuperheater can be located wherever is convenient in the pipeline.
■ Large temperature change needed	■ Nozzles in multiple configurations capable of providing large amounts of spraywater to cool steam to required temperature.
■ Thermal cycling	■ The desuperheater design incorporates an integral thermal liner inside the desuperheater body pipe to minimize the potential for thermal shock when cool water is introduced.
■ Vibration-related failures	■ The nozzle mount for the Fisher DMA/AF-HTC desuperheater is engineered to minimize the potential for excitation due to vortex shedding and flow induced vibration.

## DFA Desuperheater

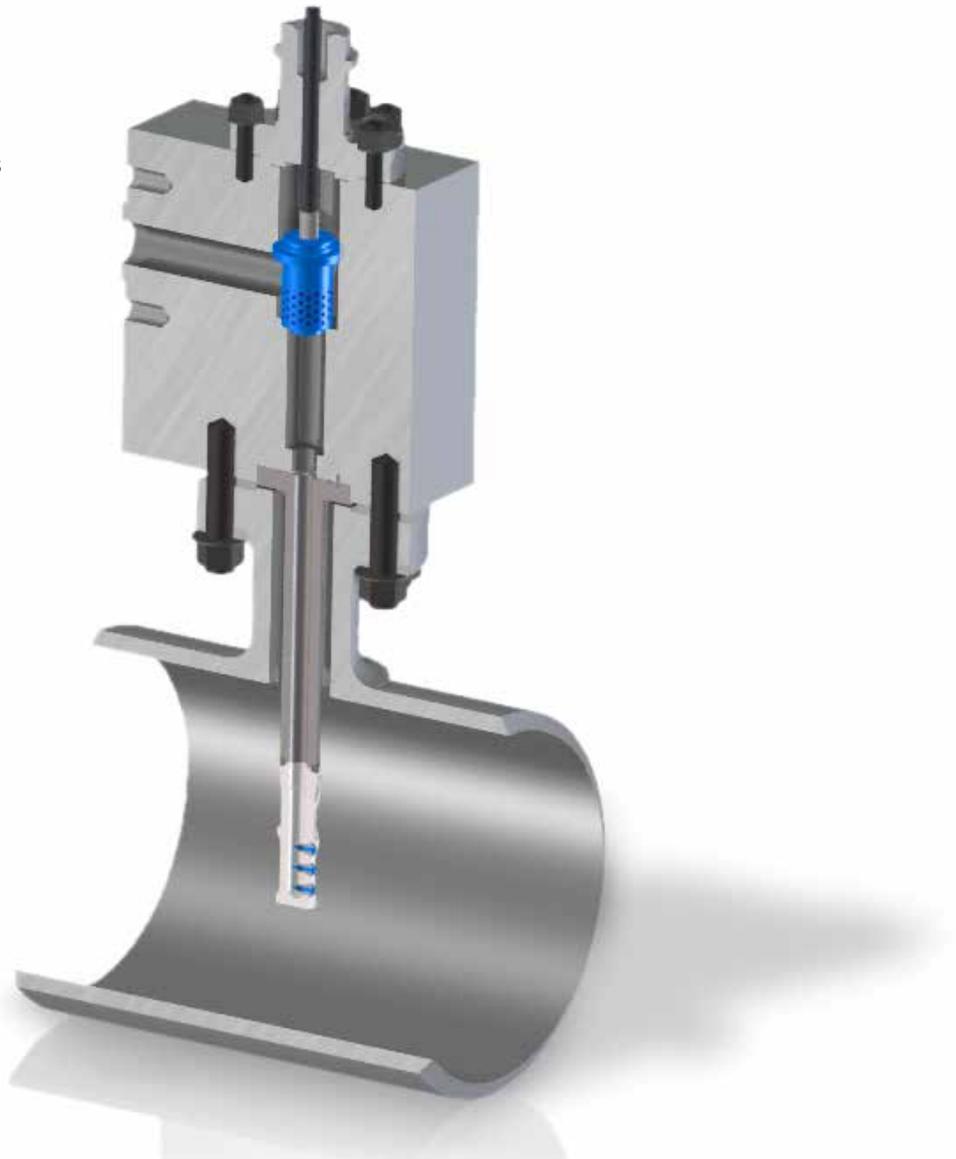
features an insertion style desuperheater that is functionally equivalent to the DMA/AF-HTC with an integrated spraywater valve. It is structurally suited for severe applications and is an all-in-one solution that allows for avoidance of costly piping modifications.

### POWER APPLICATIONS

- HP/RH Attemperator Spray
- HRSG Interstage Desuperheating
- Auxiliary Steam

### PROCESS APPLICATIONS

- Pressure Letdown Station
- HP to LP Letdown
- Export Steam Letdown
- Process Steam Letdown
- Auxiliary Steam



APPLICATION CHALLENGES	PROVEN FISHER® SOLUTIONS
<ul style="list-style-type: none"> <li>■ Accurate temperature control near saturation</li> </ul>	<ul style="list-style-type: none"> <li>■ Optimized spray pattern with optional AF nozzle technology allows for a wide operating range to achieve optimal mixing and quick vaporization at all flowing conditions.</li> </ul>
<ul style="list-style-type: none"> <li>■ Costly maintenance and short turnarounds</li> </ul>	<ul style="list-style-type: none"> <li>■ Valve trim and spray nozzles can be easily replaced without having to replace the entire unit.</li> </ul>
<ul style="list-style-type: none"> <li>■ Cracked welds</li> </ul>	<ul style="list-style-type: none"> <li>■ The body is constructed from forged materials with no welds present in the flow stream.</li> </ul>
<ul style="list-style-type: none"> <li>■ Piping configuration limits face-to-face availability</li> </ul>	<ul style="list-style-type: none"> <li>■ Custom designed bodies with a probe-style desuperheater, matched with multiple trim styles meet almost any face-to-face, piping, or application requirements.</li> </ul>
<ul style="list-style-type: none"> <li>■ Thermal cycling</li> </ul>	<ul style="list-style-type: none"> <li>■ The desuperheater design incorporates an integral thermal liner inside the desuperheater body pipe to minimize the potential for thermal shock when cool water is introduced.</li> </ul>
<ul style="list-style-type: none"> <li>■ Vibration-related failures</li> </ul>	<ul style="list-style-type: none"> <li>■ The nozzle mount for the Fisher DFA desuperheater is engineered to minimize the potential for excitation due to vortex shedding and flow induced vibration.</li> </ul>

## DFM Desuperheater

is functionally similar to the DMA/AF-HTC, however, it features a single flush mounted AF nozzle. It is structurally suited for severe applications where the desuperheater is exposed to high steam velocities or vortex shedding.

### POWER APPLICATIONS

- HP/RH Attenuator Spray
- Auxiliary Steam

### PROCESS APPLICATIONS

- Pressure Letdown Station
- HP to LP Steam Letdown
- Export Steam Letdown
- Auxiliary Steam Letdown



APPLICATION CHALLENGES	PROVEN FISHER® SOLUTIONS
<ul style="list-style-type: none"> <li>■ Accurate temperature control near saturation</li> </ul>	<ul style="list-style-type: none"> <li>■ Optimized spray pattern with optional AF nozzle technology allows for a wide operating range to achieve optimal mixing and quick vaporization at all flowing conditions.</li> </ul>
<ul style="list-style-type: none"> <li>■ Costly maintenance and short turnarounds</li> </ul>	<ul style="list-style-type: none"> <li>■ Nozzles can be easily removed, maintained, or replaced without having to replace the entire unit.</li> </ul>
<ul style="list-style-type: none"> <li>■ Cracked welds</li> </ul>	<ul style="list-style-type: none"> <li>■ DFM desuperheaters use a forged construction optimized to move weld joints away from high stress regions.</li> </ul>
<ul style="list-style-type: none"> <li>■ Piping configuration limits face-to-face availability</li> </ul>	<ul style="list-style-type: none"> <li>■ DFM desuperheaters can be located wherever is convenient in the pipeline</li> </ul>
<ul style="list-style-type: none"> <li>■ High steam velocity</li> </ul>	<ul style="list-style-type: none"> <li>■ DFM desuperheater utilizes a flush mount nozzle design to provide the ease of an insertion style desuperheater without its velocity limit.</li> </ul>
<ul style="list-style-type: none"> <li>■ Thermal cycling</li> </ul>	<ul style="list-style-type: none"> <li>■ The desuperheater design incorporates an integral thermal liner inside the desuperheater body pipe to minimize the potential for thermal shock when cool water is introduced.</li> </ul>

## DSA Desuperheater

uses high pressure steam for rapid and complete atomization of spraywater in low velocity steam lines. This insertion style desuperheater is intended for applications requiring high rangeability.

### POWER APPLICATIONS

- HP/RH Attenuator Spray
- Auxiliary Steam

### PROCESS APPLICATIONS

- Pressure Letdown Station
- HP to LP Steam Letdown
- Export Steam Letdown
- Auxiliary Steam Letdown



APPLICATION CHALLENGES	PROVEN FISHER® SOLUTIONS
<ul style="list-style-type: none"> <li>■ Costly maintenance and short turnarounds</li> </ul>	<ul style="list-style-type: none"> <li>■ Nozzles can be maintained or replaced without having to replace the entire unit.</li> </ul>
<ul style="list-style-type: none"> <li>■ Piping configuration limits face-to-face availability</li> </ul>	<ul style="list-style-type: none"> <li>■ DSA desuperheater can be located wherever is convenient in the pipeline.</li> </ul>
<ul style="list-style-type: none"> <li>■ High turndown required</li> </ul>	<ul style="list-style-type: none"> <li>■ 40:1 rangeability capable.</li> </ul>
<ul style="list-style-type: none"> <li>■ Rapid cooling needed in short distances</li> </ul>	<ul style="list-style-type: none"> <li>■ In the DSA desuperheater, high pressure steam is mixed with the spraywater to produce a critical or near-critical pressure drop in the atomizing steam for a very high velocity. The high velocity disperses the spraywater into very small particles for rapid cooling.</li> </ul>

## DVI Desuperheater

is venturi style and is used in moderate load change applications and low velocity steam. The venturi helps increase the steam velocity resulting in turbulent steam flow, which improves mixing of water and steam while increasing rangeability.

### POWER APPLICATIONS

- HP/RH Attenuator Spray
- HRSG Interstage Desuperheating
- Auxiliary Steam

### PROCESS APPLICATIONS

- Pressure Letdown Station
- HP to LP Letdown
- Export Steam Letdown
- Process Steam Letdown
- Auxiliary Steam



APPLICATION CHALLENGES	PROVEN FISHER® SOLUTIONS
<ul style="list-style-type: none"> <li>■ Accurate temperature control near saturation</li> </ul>	<ul style="list-style-type: none"> <li>■ Optimized spray pattern with optional AF nozzle technology allows for a wide operating range to achieve optimal mixing and quick vaporization at all flowing conditions.</li> </ul>
<ul style="list-style-type: none"> <li>■ Costly maintenance and short turnarounds</li> </ul>	<ul style="list-style-type: none"> <li>■ Nozzles can be easily removed, maintained, or replaced without having to replace the entire unit.</li> </ul>
<ul style="list-style-type: none"> <li>■ Cracked welds</li> </ul>	<ul style="list-style-type: none"> <li>■ The body is constructed from forged materials with no welds present in the flow stream.</li> </ul>
<ul style="list-style-type: none"> <li>■ Piping configuration limits face-to-face availability</li> </ul>	<ul style="list-style-type: none"> <li>■ The DVI desuperheater can be located wherever is convenient in the pipeline.</li> </ul>
<ul style="list-style-type: none"> <li>■ Difficult installation</li> </ul>	<ul style="list-style-type: none"> <li>■ The DVI desuperheater is easily installed between flanged steam lines.</li> </ul>
<ul style="list-style-type: none"> <li>■ Small pipelines</li> </ul>	<ul style="list-style-type: none"> <li>■ The DVI desuperheater is available in sizes as small as NPS 1.</li> </ul>

**If you found this brochure valuable, may we also recommend the following literature:**



“Fisher Power & Severe Service Sourcebook”

Document Number: D101449X012  
[www.EmersonProcess.com/Fisher/Documentation](http://www.EmersonProcess.com/Fisher/Documentation)



“Regular Nozzle Maintenance Improves Process Control and Protects Vital Equipment”

Document Number: D352066X012  
[www.EmersonProcess.com/Fisher/Documentation](http://www.EmersonProcess.com/Fisher/Documentation)



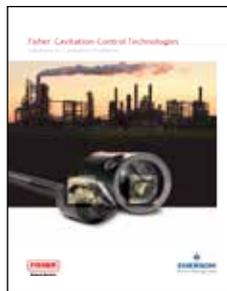
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“Fisher Cavitation-Control Technologies”

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“FIELDVUE DVC6200 Series Digital Valve Controller”

Document Number: D351908X012  
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