

**SUMMARY**

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## 0. FOREWORD

Established in 1951, AST S.p.A. is one of the first Italian manufacturers of spring-loaded safety relief valves and changeover valve systems, in the following years, since early 80's the production range has been extended by the introduction of control valves for critical services.

In the recent years heavy duty control valves with special low noise and anti-cavitation solutions and complementary products such as steam desuperheaters and steam conditioning systems for power generation field have been added to complete the production range.

## 1. RANGE OF PRODUCTS FOR POWER GENERATION

Thanks to a wide range of products specially developed for service on critical applications AST can supply control valves and systems to satisfy whichever process requirements in the power generation industry.

Conventional control valves, cage balanced, low-noise, anti-cavitation and anti-erosion labyrinth trims are available and properly selected and sized in accordance with specific process conditions and service requirements by well expertise technical team.

Advanced technical solutions allow to warrant best performances and high reliability also for service on extreme pressure and temperature.

Wide range of actuation solutions is available: pneumatic actuators with mechanical or hydraulic side or top mounted hand-wheels, electric or electro hydraulic actuators.

### 1.1. CONTROL VALVES

**1.1.1. CV-8400 & CV-8700 – Straight-way and angle body valve with screwed seat and contoured plug**

**1.1.2. CV-8450 & CV-8750 – Straight-way and angle body valve with quick-change trim**

**1.1.3. Single cage trims standard and low noise**

**1.1.4. Double cage, anti-cavitation trims**

**1.1.5. Triple cage, anti-cavitation trims**

**1.1.6. VeCo-LT, multi-path multi-stage labyrinth trims**

**1.1.7. Vary-VeCo, variable stages labyrinth trims**

**1.1.8. Tandem plug, multiple cage trims**

### 1.2. STEAM DESUPERHEATERS

**1.2.1. DS-3100 – Venturi Nozzle**

**1.2.2. DS-3200 – Fixed Area nozzle**

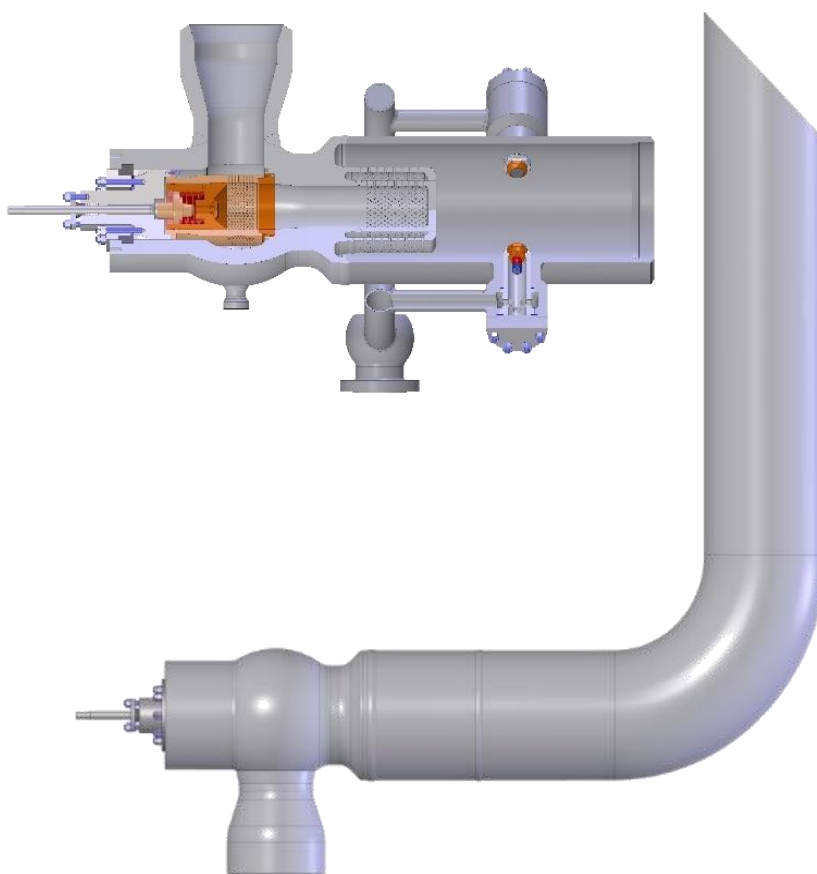
**1.2.3. DS-3400 – Variable Area nozzle**

**1.2.4. DS-3600 – Steam Atomized nozzle**

**1.2.5. DS-3700 – Actuated Multi Nozzle**

### 1.3. SYSTEMS

The combination of CV-8000 control valves with downstream silencers and DS-3000 desuperheaters allows to produce a wide range of systems for specific applications such as steam venting to atmosphere, pressure reducing and desuperheating stations (PRDS) or steam turbine bypass stations.

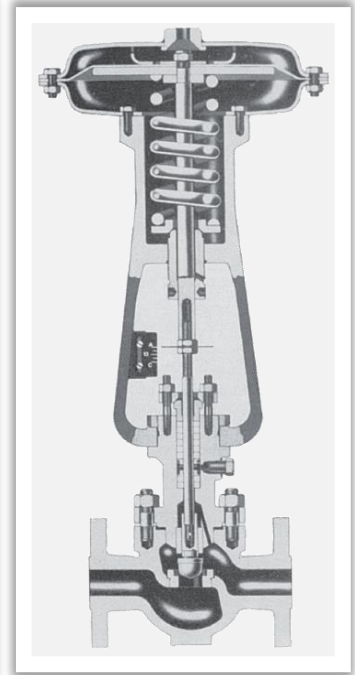


## 2. TYPICAL SERVICES

Typical services covered by AST control valves apply to Main Steam, Condensate and Feedwater Systems.

Main applications covered by standard and specialty AST valves are:

- ✓ Boiler Feedwater Recirculation Control Valve;
- ✓ Startup Feedwater Control Valve;
- ✓ Main Feedwater Control Valve;
- ✓ Spray-water Attenuator Valves;
- ✓ Deaerator Level and Pressure Control Valves;
- ✓ Condenser Level;
- ✓ Condensate Drains;
- ✓ Continuous and Intermittent Blowdown;
- ✓ Steam Desuperheaters;
- ✓ Auxiliary Steam Conditioning;
- ✓ Pressure Reducing Applications;
- ✓ Turbine Bypass Systems;
- ✓ Steam Vents to Atmosphere;



**CV-8407** – Straight way body, unbalanced, contoured plug trim control valve suitable for low duty service.

## 3. CV-8407 / CV-8707 – SCREWED SEAT CONTOURED PLUG CONTROL VALVES

### 3.1. Main features

Straight-way body **CV-8407** and angle-body **CV-8707** are, cost effective, very simple design contoured plug control valves suitable for low duty services on power generation plant.

Fixed area orifices can be installed to reduce downstream mixed phase velocity at valve outlet or at flash tank connection, can be sized and supplied by AST on request.

Special execution **CV-840M** with double stage contoured plug for low pressure anti-cavitation service is available on request to avoid cavitation on moderate service applications.

### 3.2. Materials

*Body and bonnet:* carbon steel, Cr.Mo. steel (Gr. 22, Gr. 91), stainless steel, other materials upon request.

*Trim:* Series 300 and 400 stainless with CoCr-A hard facing or surface hardening treatment in accordance with process conditions and customer specifications.

*Packing:* PTFE or graphite according to service pressure and temperature.

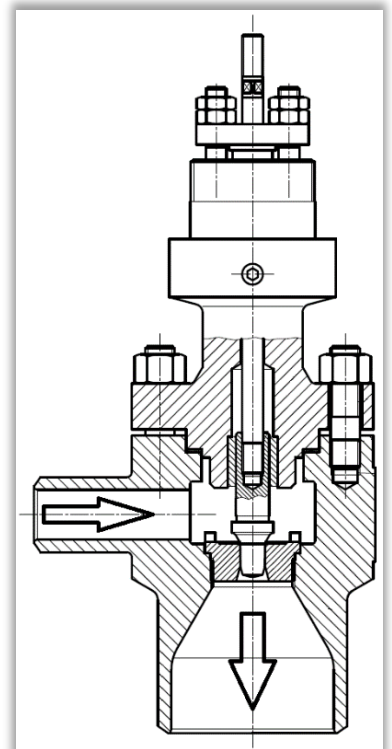
### 3.3. Sizes and Pressure Classes

*Sizes:* From NPS 1/2" to NPS 8" as standard, higher dimensions are available on request.

*Rating:* Class 150 to 1500, flanged or BW connections.

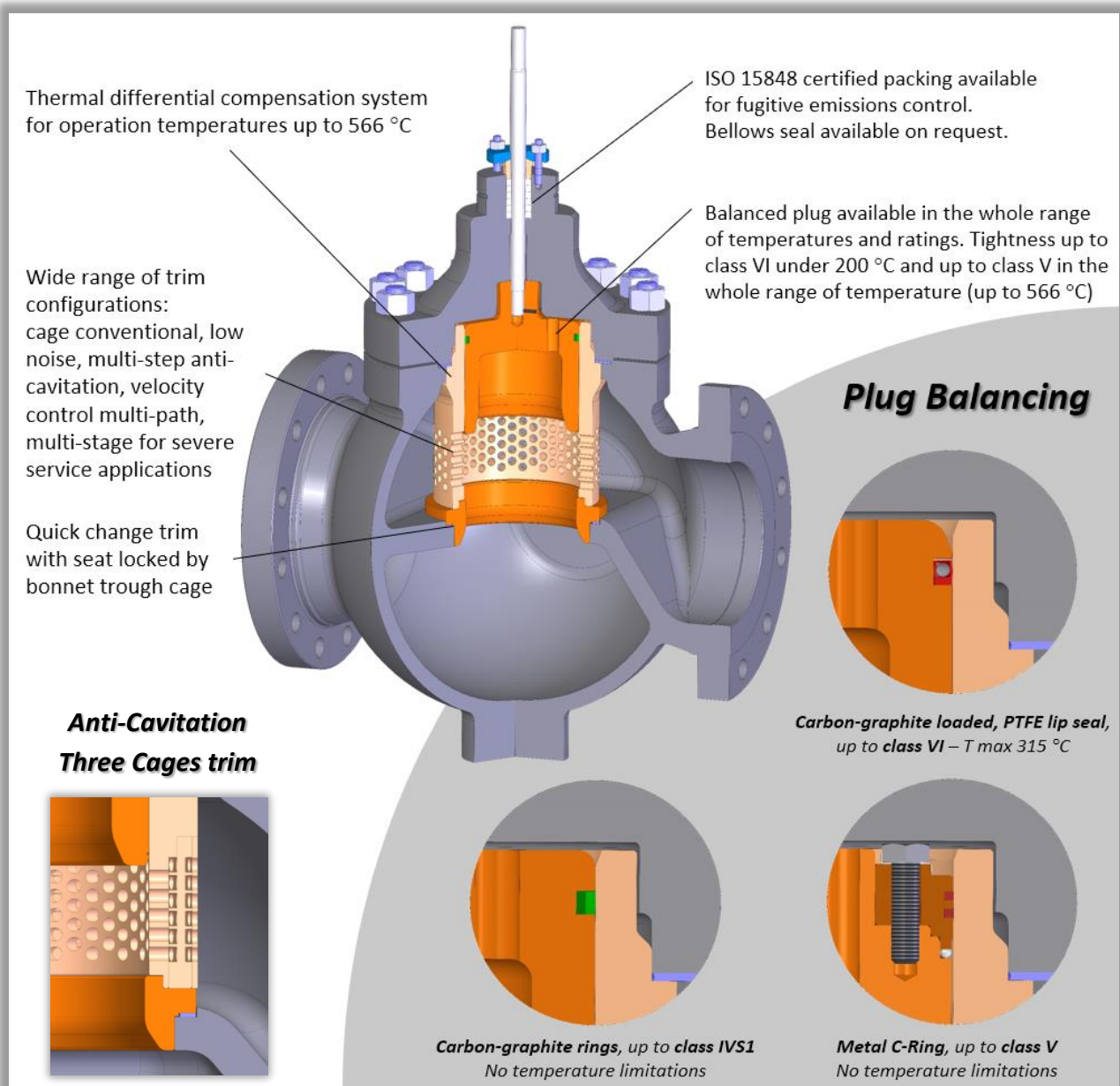
### 3.4. Seat Leakage

Leakage IEC 60534-4 / ISA FCI 70-2 classes IV and V are available as standard. Class VI with soft PTFE insert or zero leakage with metallic seal is available on request.



**CV-8707** – Angle body, contoured plug, side inlet, specialty designed for low pressure steam condensate drain to flash tank.

#### 4. CV-8450 – GLOBE QUICK CHANGE CAGE VALVE



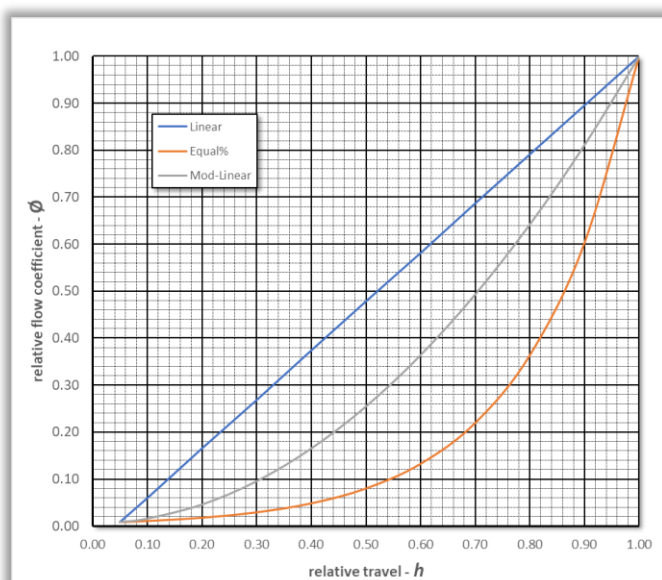
##### 4.1. Main Features

Straight-way body CV-8450 and angle body CV-8750 are cage valves with robust, simple and reliable construction specially designed for heavy duty applications. Thanks to an internal thermal compensation system these valves can extend working temperature up to 566°C.

##### 4.2. Available trims

CV-8450 valves can be equipped with a wide range of low-noise, anti-cavitation and anti-erosion trims, maintaining **quick change** design, in the flow capacity range of CV from 0.05 to over 6000, with equal percentage linear and modified linear flow characteristic. The complete series of trim allow to withstand practically all process conditions with high reliability and reduced maintenance.

A complete range of plug balancing inserts is available to reduce actuating forces and allowing reach highest sealing classes in the whole range of operating temperatures.





### 4.3. Materials

*Body and bonnet:* carbon steel, Cr.Mo. steel (Gr. 22, Gr. 91), stainless steel, other materials upon request.

*Plug:* Series 300 stainless steel or 13-4 Cr steel with surface hardening treatment up to over 1100 HV, with CoCr-A hard facing on sealing surfaces according to process conditions.

*Seat:* Series 400 hardened stainless steel or AISI 316 with CoCr-A hard facing.

*Cage:* Series 300 Cr plated stainless steel or 13-4 Cr steel with surface hardening treatment up to over 1100 HV.

**VeCo-LT:** AISI 300 or 400 stainless steel sheets, solid Inconel 718 by additive manufacturing for small trims with micro labyrinths.

*Packing:* PTFE or graphite according to service pressure and temperature.

### 4.4. Sizes and Pressure Classes

*Size:* From NPS 3/4" to NPS 24" as standard, higher dimensions are available on request.

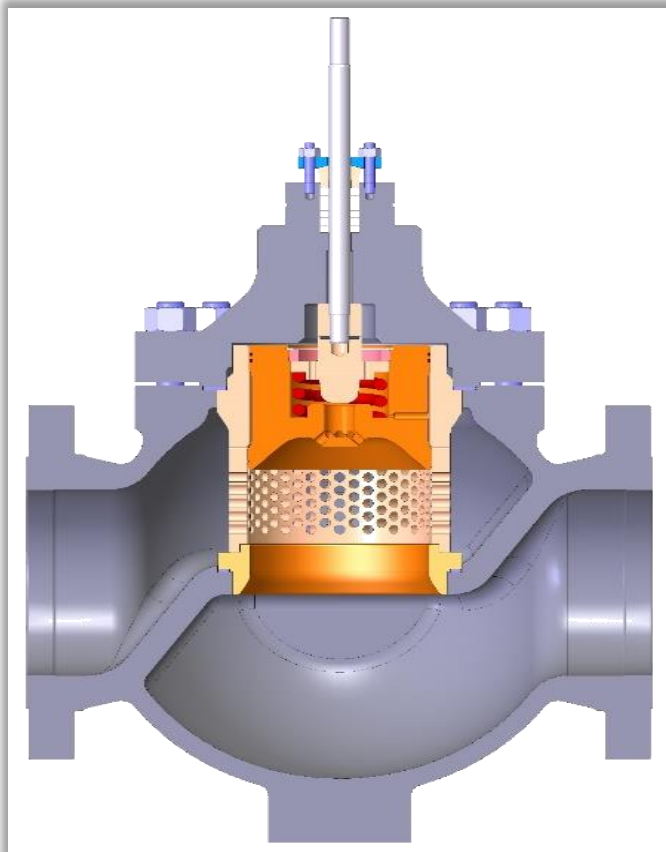
*Rating:* Class 150 to 2500, flanged or BW connections.

### 4.5. Seat leakage IEC 60534-4 / ISA FCI 70-2

Classes IV and V are available as standard in the whole range of temperature with balanced plug.

Class VI with PTFE insert is available up to 200 °C.

Balanced trim with **pilot plug (CV-8054)** is available for **high temperature** steam service applications, when **zero leakage** is required.



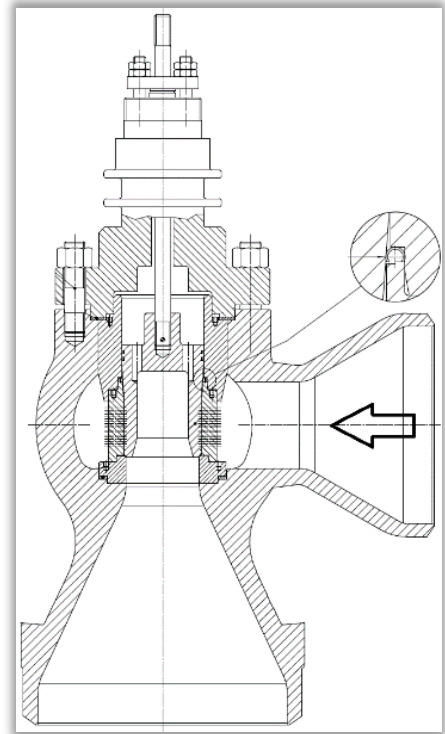
**CV-8454** – Straight way, globe valve with flow over the plug and pilot balanced plug.

### 4.6. Low-noise, anti-cavitation and anti-erosion special trims details

#### 4.6.1. Low noise micro drilled cages

AST low noise cage trims are available for the standard series **CV-8451** in the configuration **NR** (noise reduction) and **HNR** (high efficiency noise reduction) with linear, equal-percentage or linear modified flow characteristic.

These trims allow to reduce produced noise on compressible fluid service up to 20 dBA with reference to conventional trim valves thanks to high noise frequencies produced by small jets inside micro drilled cages.



**CV-8751** - Angle body, side inlet cage trim, balanced with metal C-Ring, for IP drain service.

#### 4.6.2. Multi-cage trims

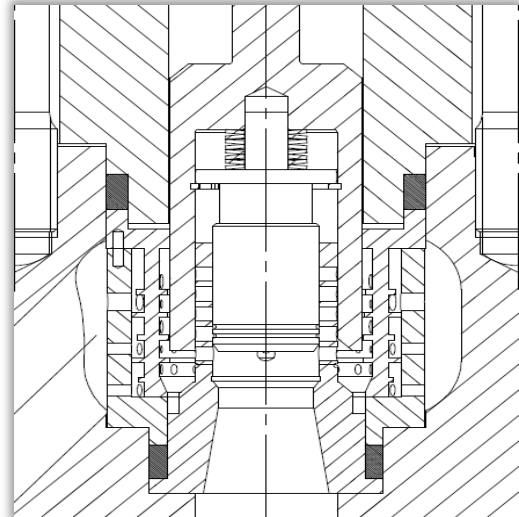
**CV-8452** with double cage and **CV-8453** with triple cage trim, are available for anti-cavitation service with moderate to high operating pressure drops (60 to 120 bar). These trims allow to avoid cavitation on most applications reaching pressure recovery factor values 0.96 to 0.99 depending on number of stages and expansion factor.

Distributed pressure drops to multiple stages and consequently reduced fluid velocity, together with a proper selection of materials, warrant a long and reliable operation also on critical services.

## 4.6.3. Tandem plug, multi-cage trim

**CV-8459** straight way and **CV-8759** angle body valves have been specially designed for service on cavitating or vaporizing fluids such as high-pressure water condensate drains.

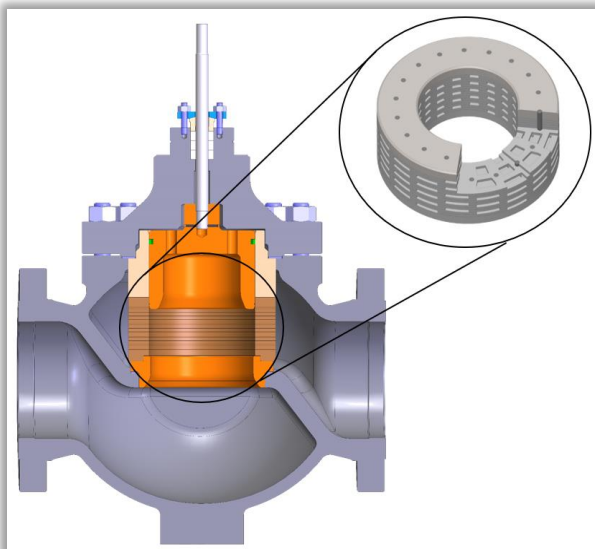
Multistage valve trim is composed by three cages made of hardened 400 series steel, and two concentric plugs. The external one is not directly involved on throttling and therefore not subject to any erosion; the internal one realizes the throttling on the internal cage. External plug sealing cone is backwards with reference to the fluid flow direction in order to be naturally shielded avoiding any erosion also in presence of vaporizing fluids such as saturated water. In addition to that, external plug is unbalanced and therefore, being flow direction from outside to inside the cage, the higher is the valve shutoff pressure, the higher is specific sealing force between plug and seat.



**CV-8459 / CV-8759** - Multi-cage anti-cavitation trim with tandem plug. Typical application: IP-HP drain service.

## 4.6.4. Velocity controlled, multi-path, multi-step labyrinth trim

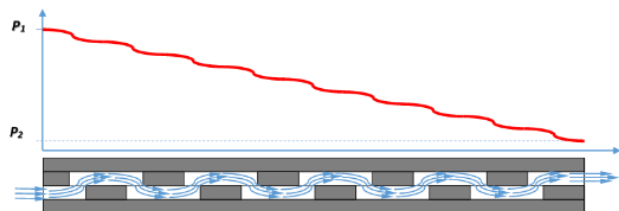
For severe service, where three stage cages are not enough to avoid cavitation or erosion on liquid service and noise reduction performed by micro drilled cages is not enough, **CV-8455** straight way and **CV-8755** angle body valves, equipped with AST **VeCo-LT** are available.



**CV-8455** – Straight-way globe valve with VeCo-LT labyrinth trim for heavy duty high pressure anti-cavitation service.

**VeCo-LT**, multi-path, multi-stages Labyrinth Trim, allow to resolve any problem of cavitation, erosion or noise thanks to the perfect control of fluid velocity and pressure distribution.

Specially designed **VeCo-LT** trims for any critical application can be designed and supplied by AST, likewise **VeCo-LT** for *continuous blowdown* service allowing to limit multi-phase fluid velocity inside trim under experienced limits to warrant a long and reliable operation.



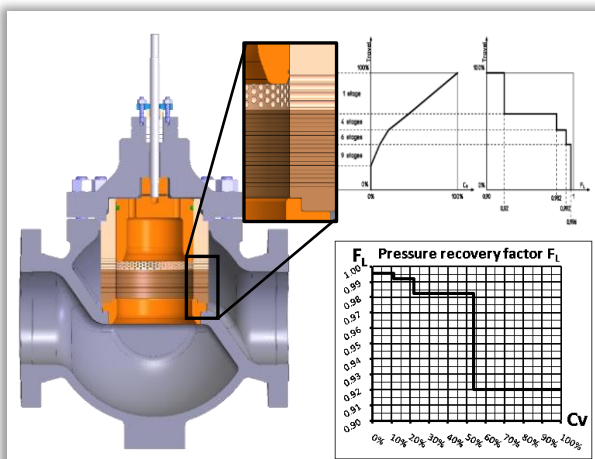
## 4.7. Multi path, variable step number labyrinth trim

**CV-8456** series with **Vary-VeCo**, multi-path, variable stage number labyrinth trim, has been specialty designed for boiler feed water applications where anti-cavitation, anti-erosion trim is required during plant startup while high capacity trim with reduced pressure drop is more suitable to reduce valve size and operating head of loss.

This valve can be installed alone avoiding the installation of 30% startup boiler feedwater valve and 100% main boiler feed-water valve.

**Vary-VeCo** trim can be convenient for all application requiring anti-cavitation or anti-erosion trim at low plant load and high specific flow coefficient at maximum load.

Particular design can be provided for compressible fluid service also.



**CV-8456** – Straight-way globe valve with Vary-VeCo for boiler feed-water service

## 5. DS-3000 – STEAM DESUPERHEATERS

AST produces a complete series of desuperheaters, based on different operating principles, allowing to solve any steam conditioning problem.

AST technicians select the most suitable type of desuperheater for the requested service and can provide to the customer the support for the configuration of the steam line layout and for the installation of the desuperheater, in compliance with the requests received and plant constraints in order to get the best operating performances.

Connection to the main steam pipe and to cooling water flanged ASME 150 to ASME 2500 as standard, connection to steam side is BW or flanged in accordance with desuperheater type and rating.

Construction materials are in accordance with customer piping classes: carbon steel, Gr.22 and gr.91 steels and stainless steels.

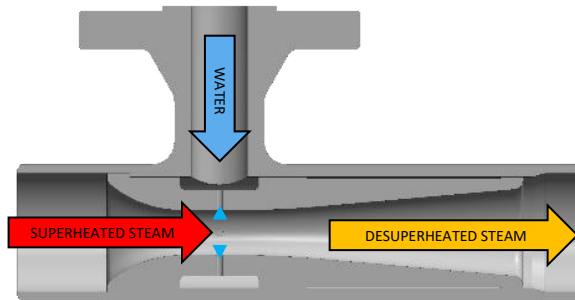
### 5.1. DS-3111 – Venturi Nozzle Desuperheaters

Venturi nozzle desuperheaters DS-3111 series are based on water atomization performed by high velocity steam impacting to injected water.

Superheated steam flow is accelerated inside the Venturi nozzle reaching maximum velocity at the nozzle minimum section where desuperheating water, controlled by an external valve, is injected.

These desuperheaters are suitable for small piping size and very low water flows. They are available starting from DN 1/2" to maximum DN 8" and they warrant an excellent atomization regardless of the available water to steam pressure drop, requiring a very short downstream length before temperature probe.

The maximum obtainable system turn-down is 5÷1 to 7÷1 depending on the maximum allowable steam head of loss and steam conditions.



### 5.2. DS-3200 – Fixed Area Nozzle Desuperheaters

Fixed area nozzle desuperheaters realize water atomization by converting water to steam pressure drop in kinetic energy producing centrifugal acceleration on water flow and consequent separation in small droplets.

Droplets dimension is as low as lower is nozzle size and high pressure drop. Typical pressure drop is limited to about 30 bar to avoid fast nozzle erosion.

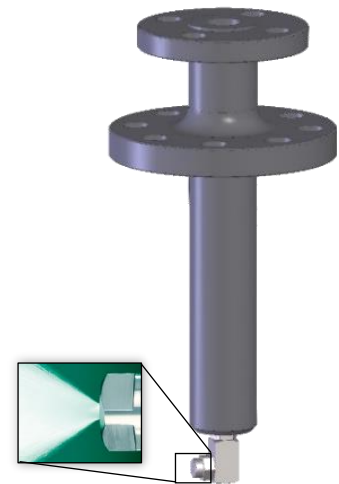
The maximum obtainable system turn-down is 5÷1 depending on the maximum available cooling water to steam pressure drop.

Fixed nozzles are typically singularly probe mounted, multiple nozzle can be installed for particular applications to increase nozzles flow capacity by reducing droplets size.

Available standard Cv range is 0.022 to 0.9.

Standard nozzle material is 300 series stainless steel.

Connections to steam pipe is flanged DN 2" to 3", water connection is flanged DN 1/2" to 1".

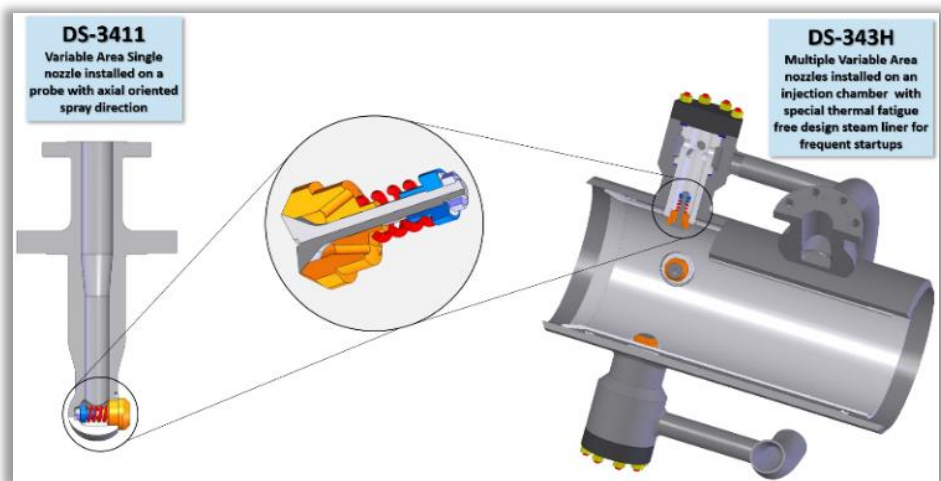


### 5.3. DS-3400 – Variable Area Nozzles Desuperheaters

As for the fixed area nozzles, the operation of the variable area nozzles is also based on the conversion of the water to steam pressure drop into kinetic energy to atomize the jet of water injected into the steam flow.

Thanks to variable area increasing with differential pressure, variable area nozzle keeps fluid velocity high since minimum flows and avoid excessive pressure drop at maximum flow, by extending

spraying rangeability compared to conventional fixed area nozzles. Thanks to spring load, at minimum flows pressure drop on the nozzle is not negligible and nozzle capacity nearby zero, producing acceptable droplets size since minimum flow.





In addition to nozzle rangeability increasing, the spring pre-load increases pressure downstream water control valve at minimum flow, reducing the risk of cavitation, and avoiding the emptying of water distribution circuit during desuperheating system inactivity. Variable area nozzles can be installed on a probe with axial spraying direction or wall mounted with radial spraying direction in a multiple nozzle arrangement.

Available maximum Cv are 0.81 – 1.62 – 3.25 – 6.5 – 9.2, with spring set 1, 3 or 6 bar.

Nozzle are made of special AISI 400 series hardened stainless steels suitable for high temperature service.

Connections to steam pipe is flanged DN 2" to 6", water connection is flanged DN ½" to 2".

### 5.4. DS-3600 – Steam Assisted Nozzles Desuperheaters

Steam assisted nozzles AST DS-3600 combine mechanical atomization obtained by water to steam pressure drop with the additional atomization produced by the impact with a jet of high velocity steam produced by an auxiliary nozzle.

Water flow is accelerated in the water nozzle producing a partial mechanical atomization.

Nozzle is composed by two independent nozzles, one for water, the second for auxiliary steam; atomizing steam, accelerated through the steam nozzle, impacts to partially atomized water jet by splitting it in a large number of small droplets.

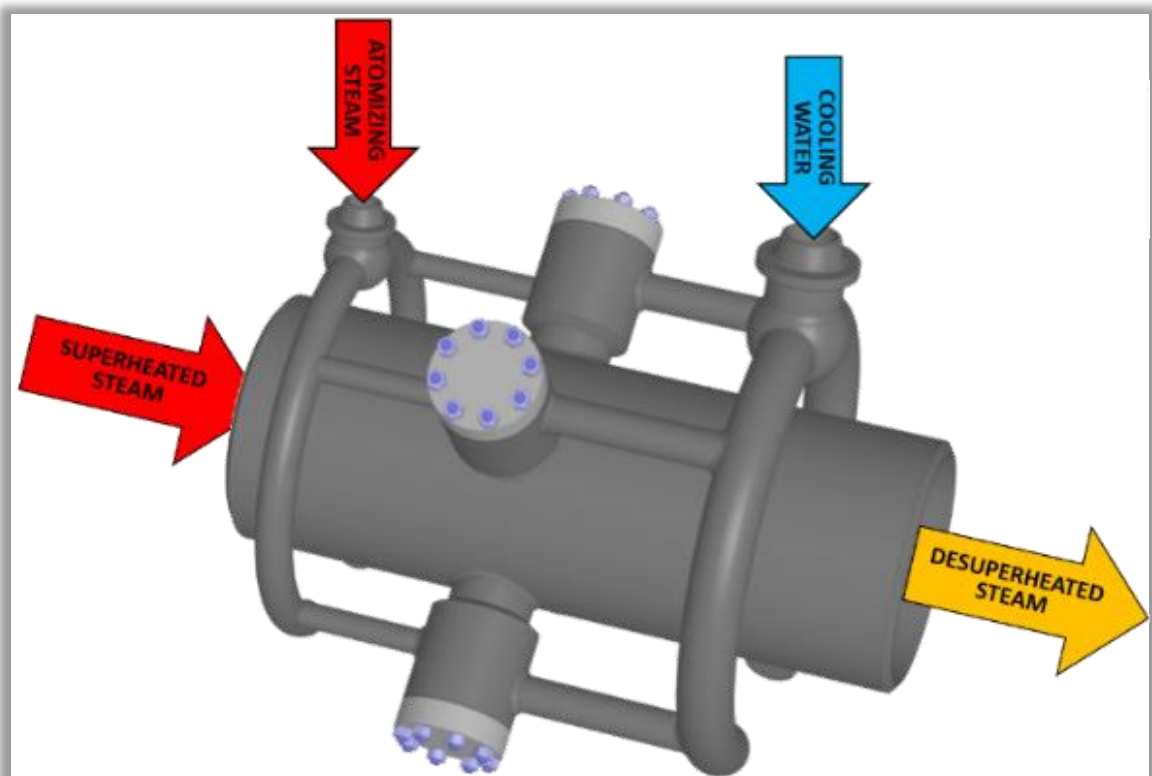
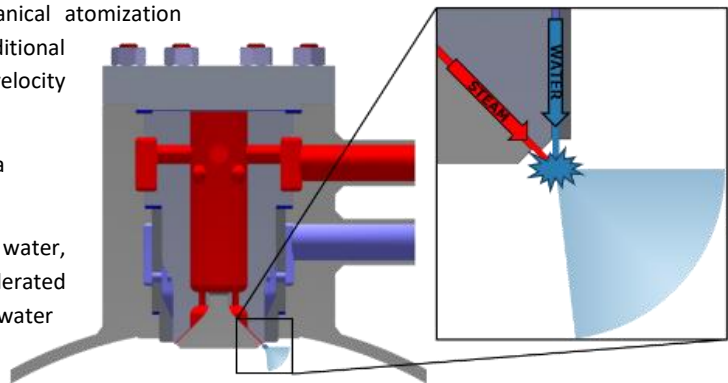
Main strengths of this solution are:

- ✓ Excellent atomization quality in the whole range of operation;
- ✓ Very high turn-down practically equal to the installed rangeability of the water control system;
- ✓ No theoretical water/steam pressure drop limitation;

However, to evaluate the use of this solution, it must also be taken into consideration that:

- ✓ Additional valve for atomizing steam is required;
- ✓ Auxiliary steam with pressure twice the desuperheated steam pressure, is required.
- ✓ Additional on-off valve for atomizing steam is required.

Steam assisted nozzles can be installed on a probe with axial spraying direction but typically they are wall mounted with radial spraying direction in a multiple nozzle arrangement.



### 5.5. DS-3700 – Actuated Multi Nozzles Desuperheaters

AST DS-3711, multi-nozzle actuated desuperheater, is the most diffused in steam production for industrial applications thanks to its easy installation, commissioning and operation.

This desuperheater is the only one not requiring an additional valve for cooling water flow control and it allows to operate with very low steam velocity when nozzles of appropriate size are installed, accordingly to the required flow rate coefficient and the maximum number of nozzles that can be installed depending on the steam side pipe dimension.

Pneumatic, electric or hydraulic actuator can be installed in accordance with customer specification.

The connection flange to steam pipe is integral with the fabricated by weld, or cast, main body.

The connection of main body to nozzles head extension is at steam side and adopt a proprietary lock solution allowing the easy change of the spray orientation respect to water inlet connection, without any welds.

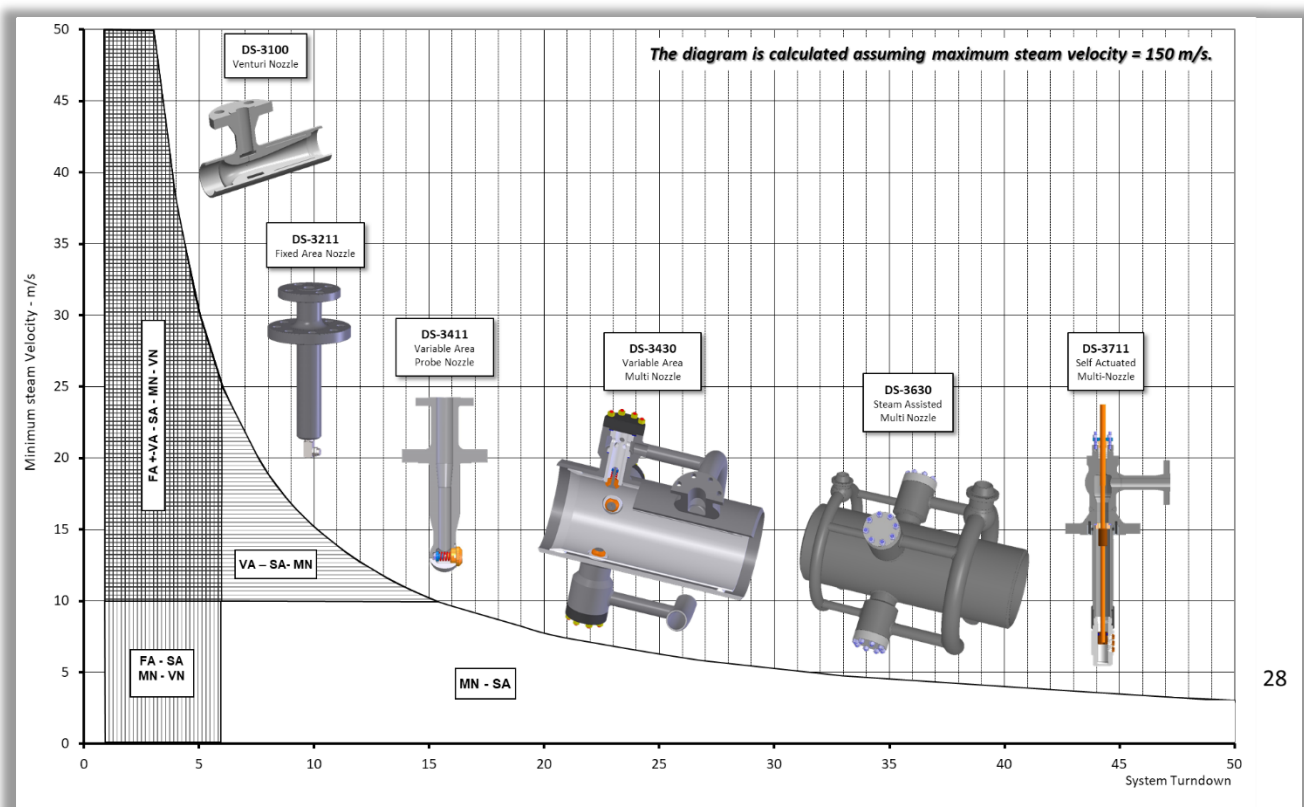
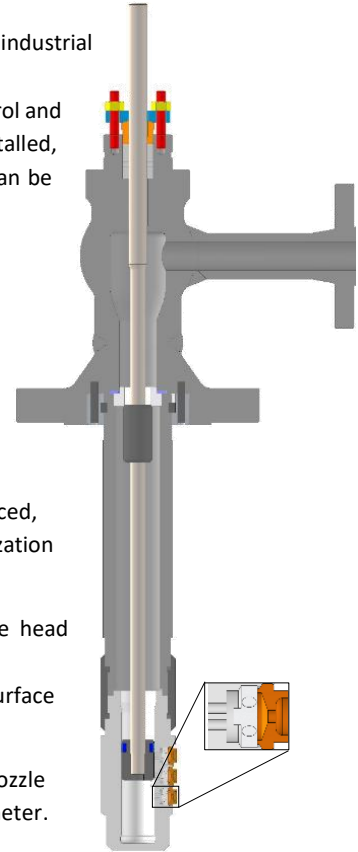
Sealing seat is clamped between main body and nozzles head extension and can be easily replaced, however, due to the complete independence between the sealing area and the nozzles partialization piston, practically no erosion occurs on the sealing surface.

Nozzles head connection to extension design is thermal fatigue-proof and allows complete head replacement not requiring any welding.

All main components involved in the water control and atomization are made of hardened or surface hardened series 400 stainless-steel, suitable for high temperature service.

A special version in stainless steel is available on request for particular applications. Available nozzle combination Cv 0.1 to over 20 in accordance with nozzles head size, limited by steam pipe diameter.

Connections to steam pipe is flanged DN 2", 3" or 6", water connection is flanged DN 1" to 3" up to Class 2500, higher rating available on request.



The diagram reports field of application of various AST steam desuperheating solutions as function of required system turndown and minimum steam velocity at injection point.

## 6. SYSTEMS

By the combination of AST control valves and desuperheaters with additional noise reduction: drilled plates, fixed area concentric cylindrical silencers or multi stage conventional or **VeCo-LT**, unlimited number of systems can be supplied to comply with whichever application.

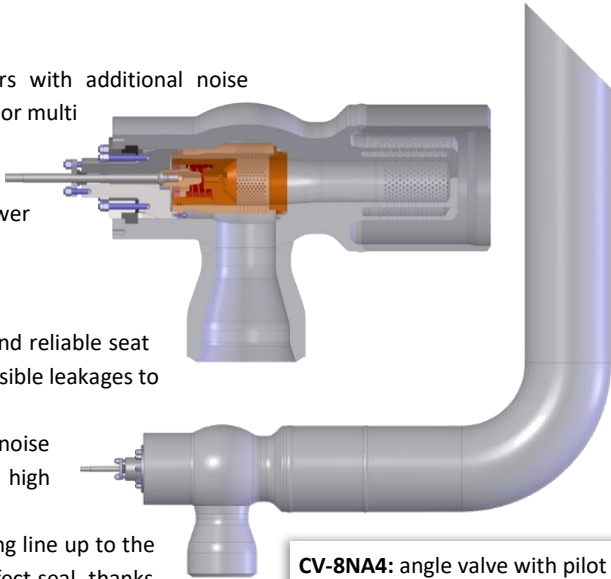
Following a few examples of most frequent application on power plants are for the following services.

### 6.1. Steam vent to Atmosphere

Steam vent to atmosphere service requires valves with perfect and reliable seat sealing to avoid steam leakage producing early trim erosion and visible leakages to atmosphere.

In addition, steam venting systems must produce reduced noise emissions avoiding production of vibration due to uncontrolled high flow velocity inside valve body and downstream piping.

AST can support customer for a proper sizing and design of venting line up to the absorbing outlet silencer, and can supply control valves with perfect seal, thanks to the pilot balanced plug, with fixed area active silencers (**VeCo-LT** based silencer more critical application is available too) installed at valve outlet to minimize valve body warranting acoustic performances.

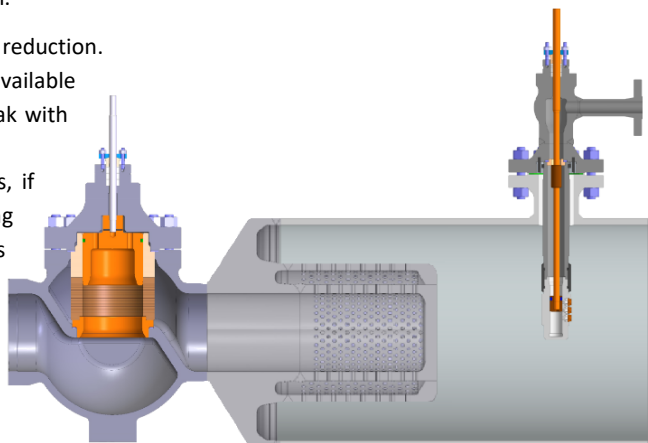


**CV-8NA4:** angle valve with pilot balanced plug trim and downstream fixed-area multi step cage silencer

### 6.2. Steam pressure reducing and desuperheating systems (PRDS)

Thanks to the wide range of control valve and steam desuperheaters, AST can supply pressure reducing and desuperheating stations for whichever application regardless its criticality and dimension.

- ✓ Special low noise or labyrinth trims are available for noise reduction.
- ✓ Different balancing inserts or pilot balanced plug are available allowing to reduce actuating forces and limiting valve leak with closed valve.
- ✓ System layout can be designed with fixed area silencers, if appropriate, to minimize valve dimension reducing produced noise and excluding valve and piping vibrations due to process fluid elevated velocity.
- ✓ Desuperheaters are installed immediately downstream control valve, or silencer, in the more appropriate position to minimize the overall dimensions, maximizing the secondary water atomization by process steam.
- ✓ Internal liner for pipe wall protection from thermal fatigue due to impact of injected water droplets is supplied for more critical applications.
- ✓ Anti-cavitation and anti-erosion trim, perfect seal valves are available for cooling water control.
- ✓ Full support for piping layout design by AST experts is available for PRDS or stand-alone desuperheaters.

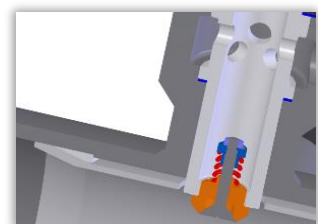
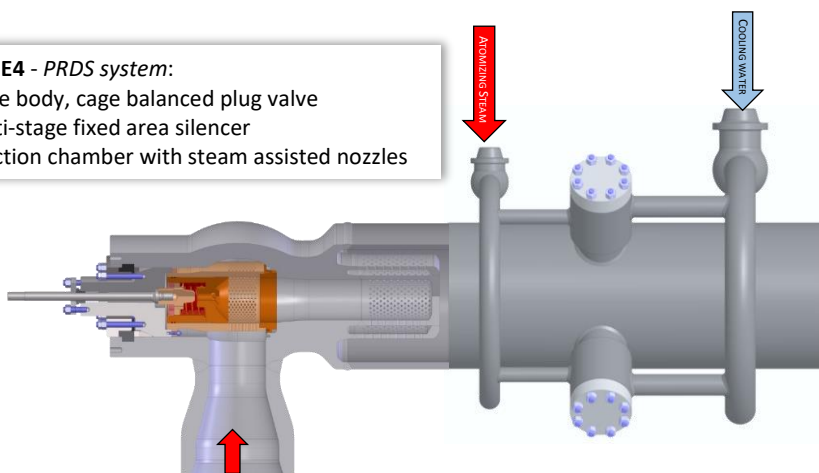


#### CV-8CF1 - PRDS system:

- straight-way cage balanced plug valve with low-noise trim
- multi-stage fixed area silencer
- injection chamber with protection liner
- self-actuated multi-nozzle desuperheater

#### CV-8NE4 - PRDS system:

- angle body, cage balanced plug valve
- multi-stage fixed area silencer
- injection chamber with steam assisted nozzles



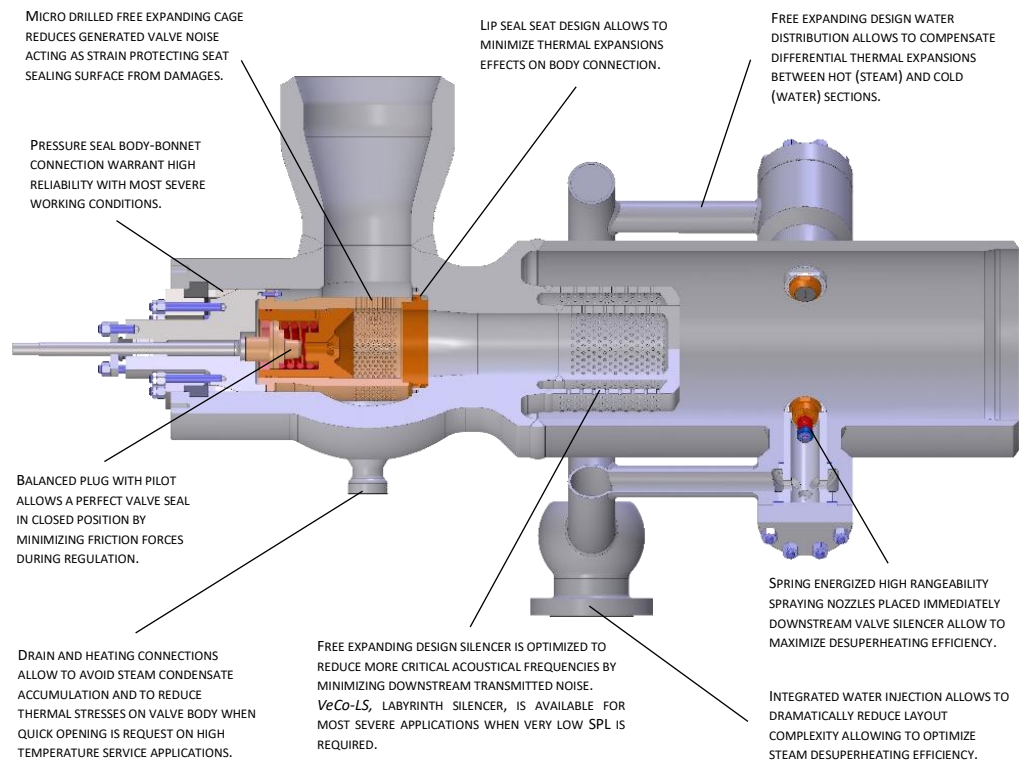
Liner for piping protection with thermal fatigue-free design for applications with frequent start-ups.

### 6.3. Steam Turbine bypass Systems

A complete series of CV-8000 systems with angled body and balanced plug with pilot has been specifically designed for severe steam conditioning services such as steam turbine bypass and all applications where perfect seal, frequent start-up from cold or warm conditions and fast opening is required, such as example technical steam emergency lines.

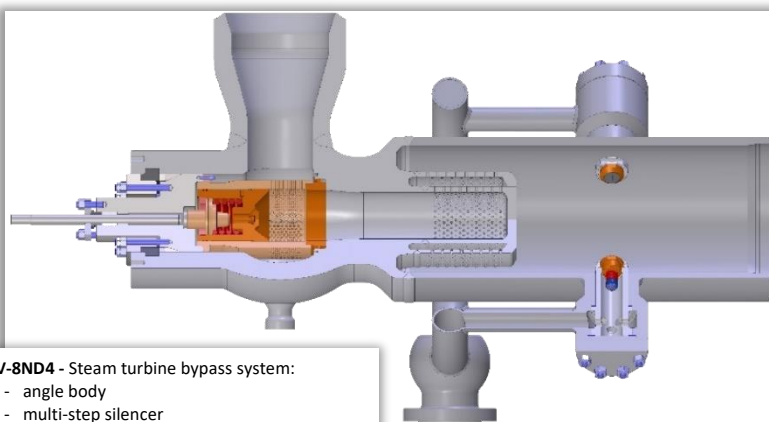
Available dimensions and ratings up to 30" and Class 4500 for upstream section and up to 80" for downstream connection.

Available materials are carbon steel, Cr.Mo. steels (grade 22, 91 and 92) and stainless steels for high temperature service, such as AISI 347H, on request.



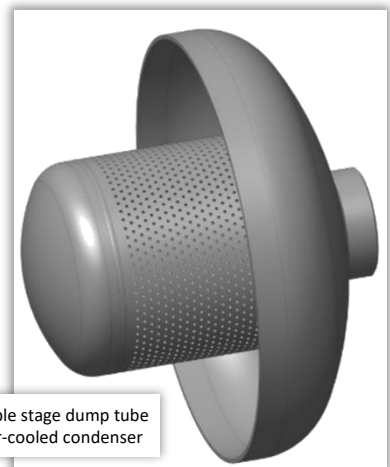
#### CV-8ND4 steam turbine bypass valve - Main Features:

- ✓ Bonnet to body connection with high reliability pressure seal.
- ✓ Spherical body shape to reduce thickness variation improving side inlet connection welded joint quality and maximizing P/T fatigue resistance (verified according to TRD 301).
- ✓ Flow to close design to keep more uniform the upstream section temperature.
- ✓ Pilot operated balanced plug warranting a perfect seal.
- ✓ Seat welded to valve body by a free expanding and easy-to-remove lip seal joint.
- ✓ Low Noise design trim with micro-drilled cage.
- ✓ Fixed area silencers or built-in Labyrinth Silencer **VeCo-LT (CV-8PD4)** for extreme low-noise service.
- ✓ Built-in water injection system with free expanding design.
- ✓ Variable area nozzles avoiding water distribution system emptying and generating water control valve backpressure.

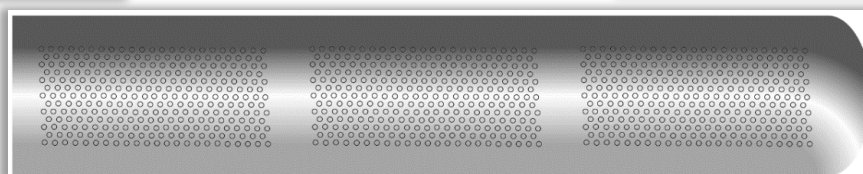


**CV-8ND4** - Steam turbine bypass system:

- angle body
- multi-step silencer
- variable area, multiple nozzles desuperheater
- pilot operated, balanced plug



Double stage dump tube to air-cooled condenser

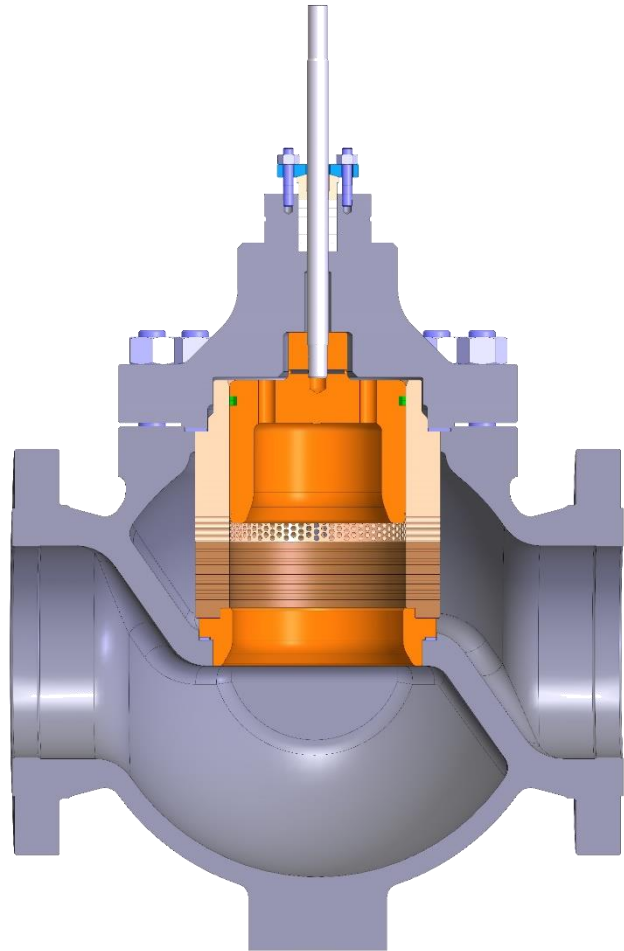


Single stage dump tube to water-cooled condenser

## 7. CODING SYSTEM

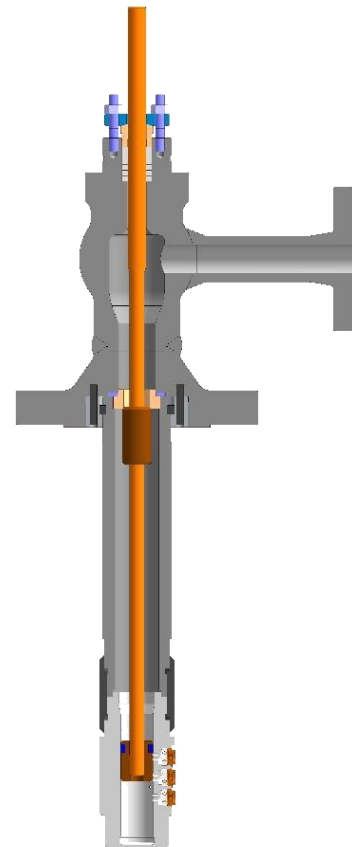
### 7.1. VALVES

|      | Body Shape  | Construction   | Trim Type   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
|------|---|--|---|--------------|-------------|-------------------|-------------|---|-------------|---|---------------------|---|---------|---|-----------|---|----------------|---|---------------------------|---|-------------|---|----------------------|---|--------------------|
| CV-8 | X   | Y  | Z   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
|      |   |  | <table><tr><td>1</td><td>Single Cage</td></tr><tr><td>2</td><td>Double Cage</td></tr><tr><td>3</td><td>Triple Cage</td></tr><tr><td>4</td><td>Pilot Operated Plug</td></tr><tr><td>5</td><td>VeCo-LT</td></tr><tr><td>6</td><td>Vary-VeCo</td></tr><tr><td>7</td><td>Contoured Plug</td></tr><tr><td>8</td><td>Contoured - Integral Stem</td></tr><tr><td>9</td><td>Tandem plug</td></tr><tr><td>B</td><td>Contoured - Balanced</td></tr><tr><td>M</td><td>Multistage Cascade</td></tr></table> | 1            | Single Cage | 2                 | Double Cage | 3 | Triple Cage | 4 | Pilot Operated Plug | 5 | VeCo-LT | 6 | Vary-VeCo | 7 | Contoured Plug | 8 | Contoured - Integral Stem | 9 | Tandem plug | B | Contoured - Balanced | M | Multistage Cascade |
| 1    | Single Cage   |  |   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
| 2    | Double Cage   |  |   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
| 3    | Triple Cage   |  |   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
| 4    | Pilot Operated Plug   |  |   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
| 5    | VeCo-LT   |  |   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
| 6    | Vary-VeCo   |  |   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
| 7    | Contoured Plug  |  |   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
| 8    | Contoured - Integral Stem   |  |   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
| 9    | Tandem plug   |  |   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
| B    | Contoured - Balanced  |  |   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
| M    | Multistage Cascade  |  |   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
|      |   | <table><tr><td>0</td><td>Screwed Seat</td></tr><tr><td>5</td><td>Quick Change Trim</td></tr></table> | 0   | Screwed Seat | 5           | Quick Change Trim |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
| 0    | Screwed Seat  |  |   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
| 5    | Quick Change Trim   |  |   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
|      | <table><tr><td>4</td><td>Globe Straight Way Body</td></tr><tr><td>5</td><td>Offset Body</td></tr><tr><td>7</td><td>Angle Body</td></tr></table> | 4  | Globe Straight Way Body   | 5            | Offset Body | 7                 | Angle Body  |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
| 4    | Globe Straight Way Body   |  |   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
| 5    | Offset Body   |  |   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |
| 7    | Angle Body  |  |   |              |             |                   |             |   |             |   |                     |   |         |   |           |   |                |   |                           |   |             |   |                      |   |                    |



### 7.2. DESUPERHEATERS

|      | Nozzle type  | Installation  | Chamber   |                       |                   |                       |                      |                              |                           |   |   |  |  |
|------|--|---|---|-----------------------|-------------------|-----------------------|----------------------|------------------------------|---------------------------|---|---|--|--|
| DS-3 | X  | Y   | Z   |                       |                   |                       |                      |                              |                           |   |   |  |  |
|      |  |   | <table><tr><td>1</td><td>Stand Alone</td></tr><tr><td>C</td><td>Injection Chamber</td></tr><tr><td>L</td><td>Injection Chamber + Liner</td></tr><tr><td>H</td><td>Injection Chamber + H.F.S. <sup>(1)</sup> Liner</td></tr></table> | 1                     | Stand Alone       | C                     | Injection Chamber    | L                            | Injection Chamber + Liner | H | Injection Chamber + H.F.S. <sup>(1)</sup> Liner |  |  |
| 1    | Stand Alone  |   |   |                       |                   |                       |                      |                              |                           |   |   |  |  |
| C    | Injection Chamber  |   |   |                       |                   |                       |                      |                              |                           |   |   |  |  |
| L    | Injection Chamber + Liner  |   |   |                       |                   |                       |                      |                              |                           |   |   |  |  |
| H    | Injection Chamber + H.F.S. <sup>(1)</sup> Liner  |   |   |                       |                   |                       |                      |                              |                           |   |   |  |  |
|      |  | <table><tr><td>1</td><td>Probe - Single Nozzle</td></tr><tr><td>2</td><td>Probe - Multi-nozzles</td></tr><tr><td>3</td><td>Wall-mounted - Multi-nozzles</td></tr></table> | 1   | Probe - Single Nozzle | 2                 | Probe - Multi-nozzles | 3                    | Wall-mounted - Multi-nozzles |                           |   |   |  |  |
| 1    | Probe - Single Nozzle  |   |   |                       |                   |                       |                      |                              |                           |   |   |  |  |
| 2    | Probe - Multi-nozzles  |   |   |                       |                   |                       |                      |                              |                           |   |   |  |  |
| 3    | Wall-mounted - Multi-nozzles   |   |   |                       |                   |                       |                      |                              |                           |   |   |  |  |
|      | <table><tr><td>1</td><td>Venturi Nozzle</td></tr><tr><td>2</td><td>Faxed Area Nozzle</td></tr><tr><td>4</td><td>Variable Area Nozzle</td></tr><tr><td>6</td><td>Steam Assisted Nozzle</td></tr><tr><td>7</td><td>Multi Nozzles</td></tr></table> | 1   | Venturi Nozzle  | 2                     | Faxed Area Nozzle | 4                     | Variable Area Nozzle | 6                            | Steam Assisted Nozzle     | 7 | Multi Nozzles                                   |  |  |
| 1    | Venturi Nozzle   |   |   |                       |                   |                       |                      |                              |                           |   |   |  |  |
| 2    | Faxed Area Nozzle  |   |   |                       |                   |                       |                      |                              |                           |   |   |  |  |
| 4    | Variable Area Nozzle   |   |   |                       |                   |                       |                      |                              |                           |   |   |  |  |
| 6    | Steam Assisted Nozzle  |   |   |                       |                   |                       |                      |                              |                           |   |   |  |  |
| 7    | Multi Nozzles  |   |   |                       |                   |                       |                      |                              |                           |   |   |  |  |

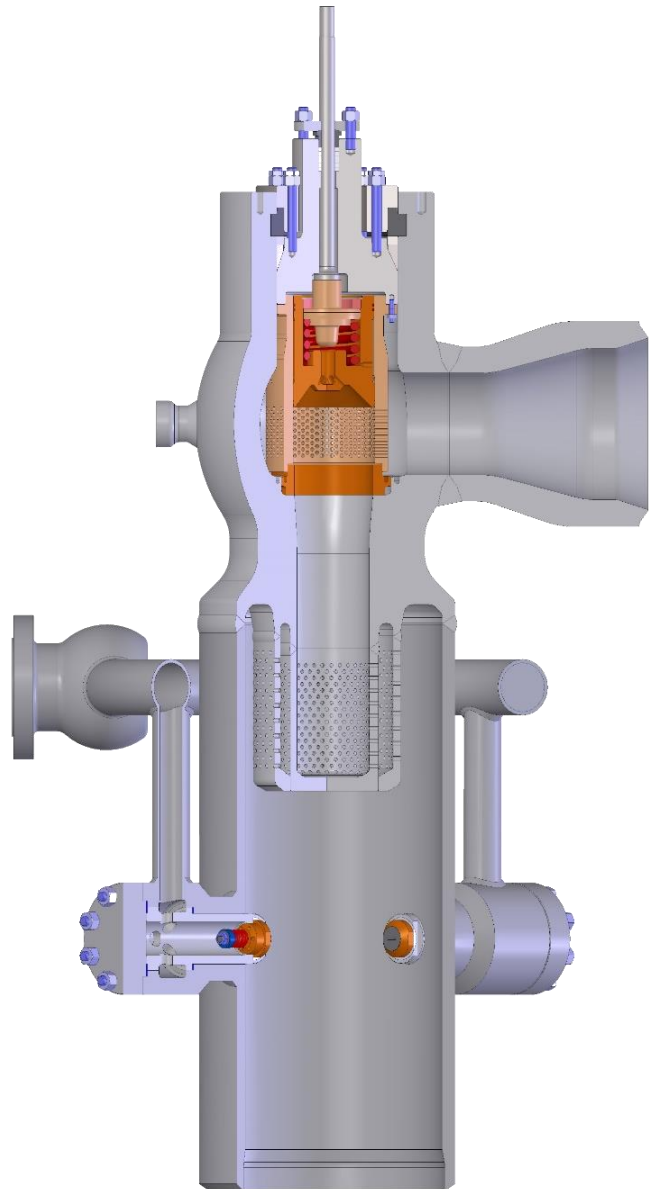


<sup>(1)</sup> H.F.S. = High Frequency Startup



### 7.3. SYSTEMS

|          |                        |                      |   |   |  |                      |
|----------|------------------------|----------------------|---|---|--|----------------------|
|          | <i>Silencer Stages</i> | <i>Desuperheater</i> | <i>Trim Type</i>                                |   |  |                      |
| CV-8     | X                      | Y                    | Z   |   |  |                      |
|          |                        |                      | <i>1</i>  | 1 Cage  |  |                      |
|          |                        |                      | <i>2</i>  | 2 Cages                                       |  |                      |
|          |                        |                      | <i>3</i>  | 3 Cages                                       |  |                      |
|          |                        |                      | <i>4</i>  | Pilot Balanced Plug                           |  |                      |
|          |                        |                      | <i>5</i>  | VeCo-LT                                       |  |                      |
|          |                        |                      | <i>6</i>  | Vary-VeCo                                     |  |                      |
|          |                        |                      | <i>7</i>  | Contoured Plug                                |  |                      |
|          |                        |                      | <i>8</i>  | Contoured - Integral Stem                     |  |                      |
|          |                        |                      | <i>9</i>  | Tandem Plug                                   |  |                      |
|          |                        |                      | <i>B</i>  | Contoured - Balanced                          |  |                      |
|          |                        |                      | <i>M</i>  | Multi-stage Cascade                           |  |                      |
|          |                        |                      | <i>A</i>  | None  |  |                      |
|          |                        |                      | <i>B</i>  | Probe - Fixed Area Nozzle                     |  |                      |
|          |                        |                      | <i>C</i>  | Probe - Variable Area Nozzle                  |  |                      |
|          |                        |                      | <i>D</i>  | Wall Mounted - Multi-nozzle                   |  |                      |
|          |                        |                      | <i>E</i>  | Steam Assisted Nozzles                        |  |                      |
|          |                        |                      | <i>G</i>  | Venturi Nozzle                                |  |                      |
|          |                        |                      | <i>H</i>  | Internal Injection                            |  |                      |
|          |                        |                      | <i>Straight Body</i><br><i>Based on CV-8400</i> | <i>Offset Body</i><br><i>Based on CV-8500</i> | <i>Angle Body</i><br><i>Based on CV-8700</i> |                      |
|          |                        |                      | <i>A</i>  | <i>E</i>                                      | <i>L</i>                                     | <i>Nr. of STAGES</i> |
| <i>B</i> | <i>F</i>               | <i>M</i>             | None  |   |  |                      |
| <i>C</i> | <i>G</i>               | <i>N</i>             | 1 Stage   |   |  |                      |
| <i>D</i> | <i>H</i>               | <i>P</i>             | Multi Stage                                     |   |  |                      |
|          |                        |                      | VeCo-LS   |   |  |                      |

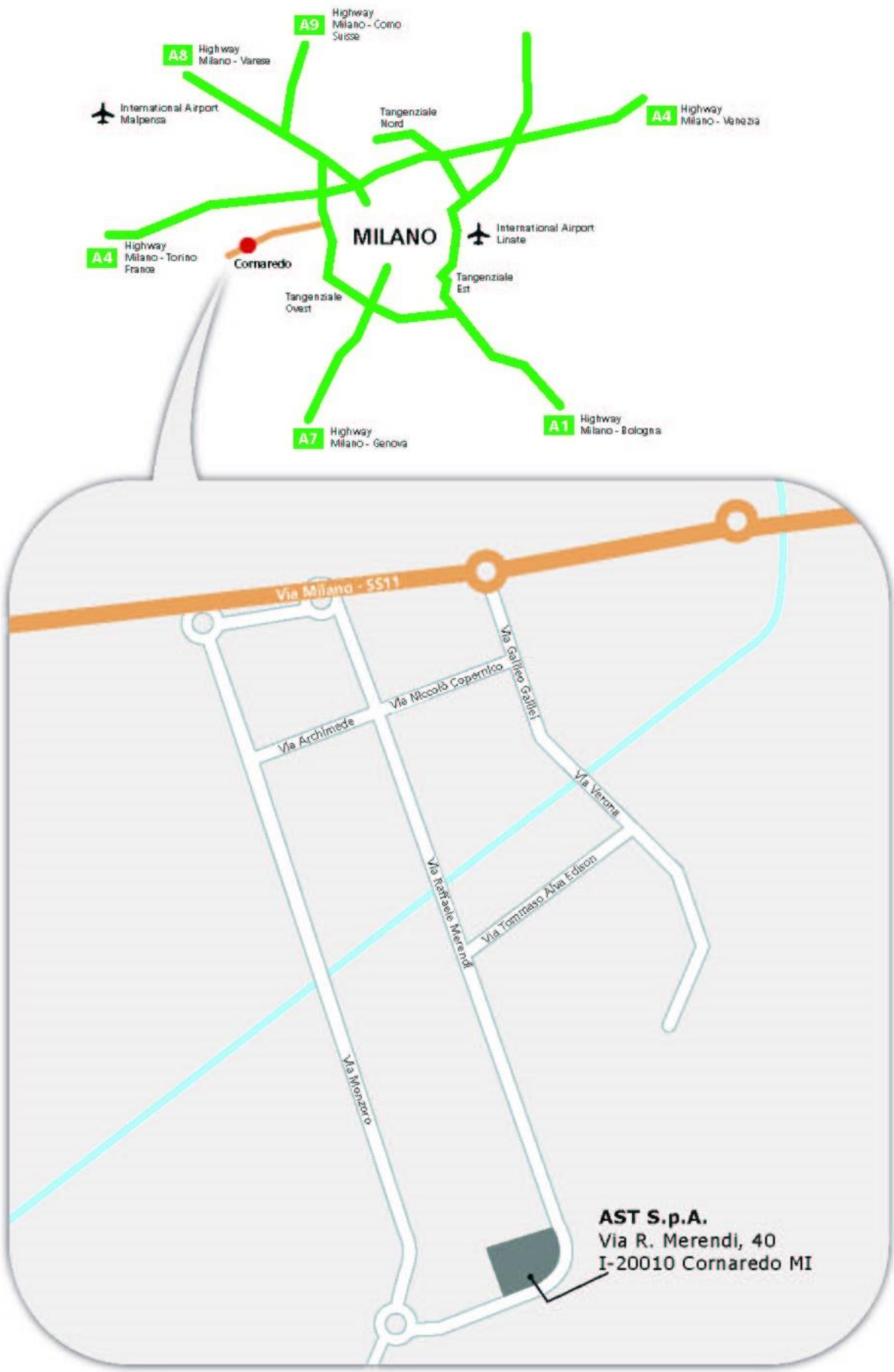



### 8. OPTIONS

- Devices for line blowing and washing with installed valves.
- Devices for lines hydro-testing with assembled valves.
- Special tools for assembling/disassembling valves on field.

### 9. ACCESSORIES

- Pneumatic, electropneumatic or digital positioners.
- Remote position feedback configuration for heavy duty services.
- Air set.
- Flow boosters.
- Lockup valves.
- Solenoid valves for fast strokes and for valve action to fail position.
- Mechanical stroke limiters.
- Hydraulic manual operator.





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