

BALL VALVES



SIDE ENTRY



TOP ENTRY





AST S.p.A. applies efficient and useful policies aimed at ensuring the quality of the products. The high quality level system implemented within the Company ensures all products are manufactured to the highest standards available using the latest technology.

The AST S.p.A. Quality Assurance System encompasses all activities from quotation to final inspection and on-site service. The Quality System has been qualified and certified since 1993 to EN ISO 9001:2000, and operates in accordance with API Q1.

More recently AST S.p.A. has been recognized as a manufacturer of products in compliance with the European Directive 97/23/EC (PED) and 94/9/EC (ATEX).

Full traceability of all components is achieved by means of a specifically developed bar code system that allows to trace and follow all components in real time, throughout all production stages.

AST S.p.A. products are manufactured and supplied in accordance with API 6A and API 6D.





Founded in 1951, AST S.p.A. is one of the first Italian manufacturers of spring loaded safety-relief valves and change-over valves that enable the alternative interception of the two safety relief valves assembled on and/or the replacement of one of the safety valves without interrupting plant activity.

In the following years AST S.p.A. started to manufacture special control valves able to meet the most demanding customer requirements. These valves, specifically designed for critical applications like melamine and urea plants, are typically manufactured from integral forgings made by nickel alloys. Recently, AST S.p.A., through a newly created sister company, has started working in the field of Process Automation and Safety Systems becoming a leading supplier for DCS and BMS for the Power and Process Industry.

Over the years, AST S.p.A. has experienced a continuous and steady growth of sales and having implemented a technological development of the production capacity, has improved its overall reliability and efficiency. Nowadays AST S.p.A. is perceived by the market as a reliable solution provider for the most demanding service conditions.

In consideration of the above, AST S.p.A. has further expanded its product portfolio by including ball and gate valves. The enhancement of the product lines has been made possible by combining more than half a century of valve manufacturing successful history with the experience of a group of high qualified engineers who have worked for more than two decades in the field of ball and gate valves development.

Products

- Spring loaded safety-relief valves
- Pneumatic control valves
- Change-over valves (for couple of safety valves)
- Vacuum release valves
- Ball and gate valves
- Safety relief-valves test benches
- Distributed Control System (DCS)
- Burner Management System (BMS)
- Fire and gas detection and fire-fighting systems
- Remote measure and control systems



Side Entry

BALL VALVES

The side entry bolted body version is one of the most trusted valve design in the oil and gas industry.

It combines the strength of forged components and field serviceability with cost efficiency and quick delivery.

The AST side entry ball valve body is made of three forged parts; the ball is mounted on trunnions or on bearing retainers designed to take the line pressure load.

The design allows the removal of the valve from the line and the subsequent disassembly at site for maintenance. The tightening of the bolts is achieved by hydraulic tools that allow to precisely control the applied torque.

For applications where the risk of external leakages has to be minimised, one of the two closures to body connection can be replaced by a circumferential weld. In this case the valve retains the possibility of being maintained in the field while the external leak paths are reduced by half. This solution is preferable to the fully welded design since the weld, accessible from both sides, can be fully inspected by NDE.

Valve body ends can be of flanged, welded or clamp types as requested by the customer.

Vent and drain connections are provided on valve body as requested by the applicable International Standards and/or customer specifications.

Range of Production

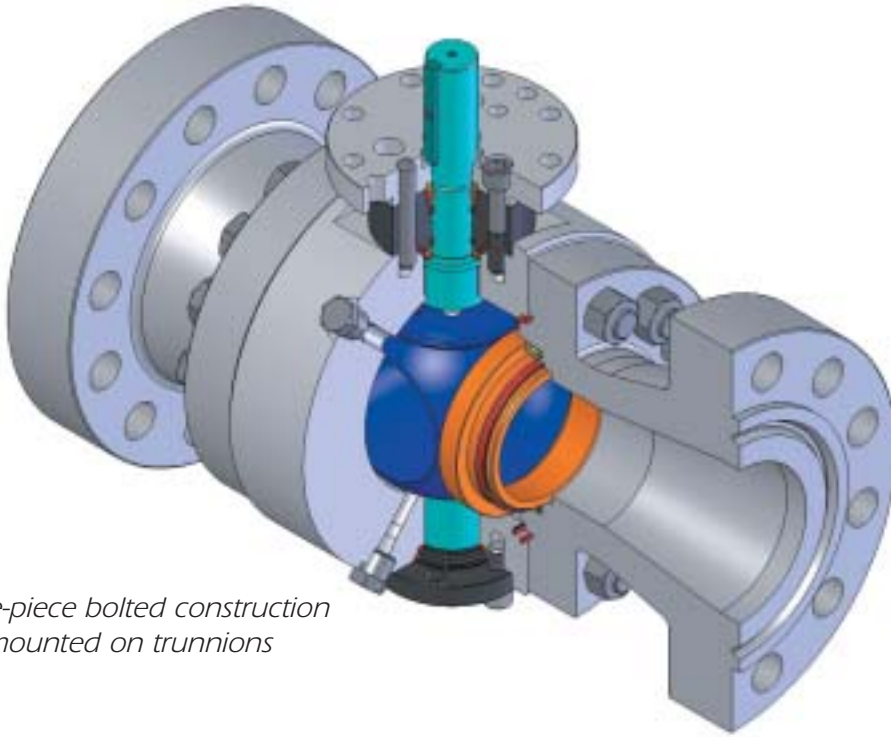
Size: from 2" to 24", full and reduced bore. Larger sizes available upon request.

ANSI Rating Class: 150 to 2,500

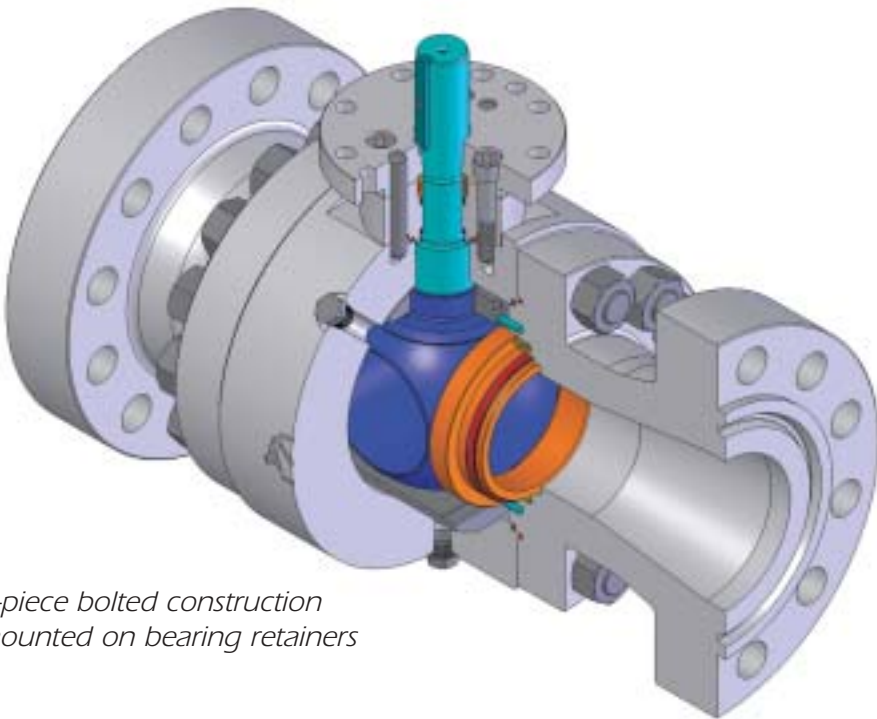
API Pressure Rating: 2,000 to 15,000 psi

Interpolated rating also available.

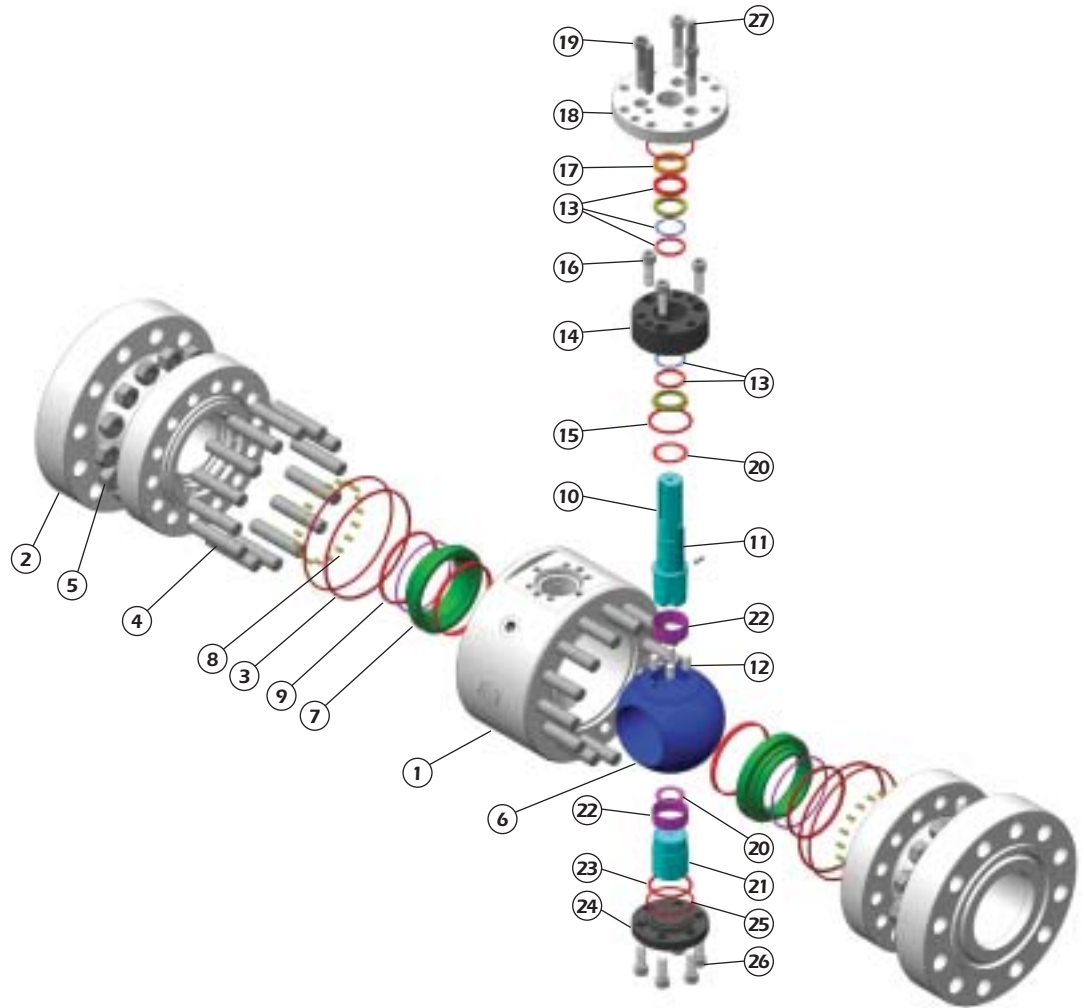
End connections: Flanged, Butt Weld or Clamp. Other special connections available upon request.



*Three-piece bolted construction
Ball mounted on trunnions*



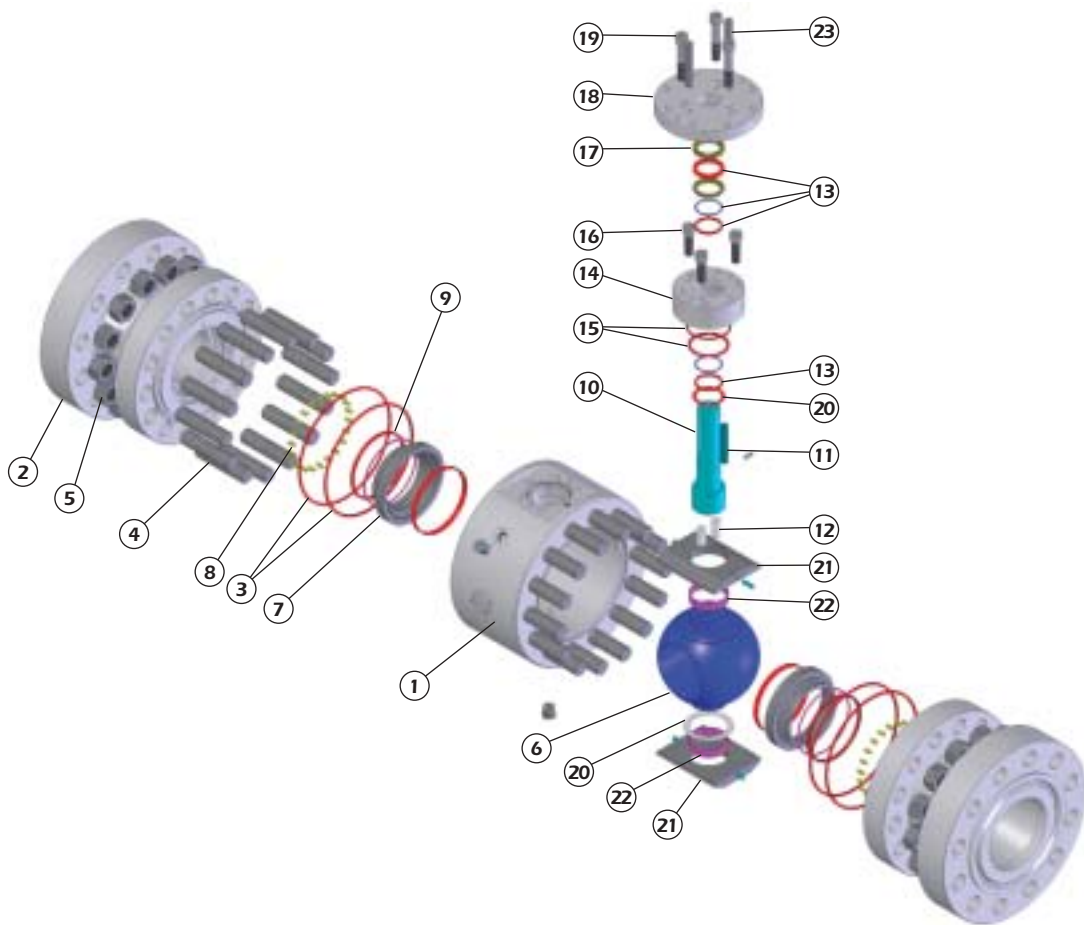
*Three-piece bolted construction
Ball mounted on bearing retainers*



Trunnion Design

1. Body	10. Stem	19. Capscrew
2. Closure	11. Key	20. Thrust Washer
3. Gasket	12. Drive Pin	21. Trunnion
4. Body Stud	13. Gasket	22. Bearing
5. Body Nut	14. Body Cover	23. Gasket
6. Ball	15. Gasket	24. Trunnion Cover
7. Seat Ring	16. Capscrew	25. Gasket
8. Seat Spring	17. Bushing	26. Capscrew
9. Gasket	18. Adapter Flange	27. Dowel Pin

The valve is designed for use with various material combinations dependent upon customer service conditions.



Bearing Retainer Design

1. Body	10. Stem	19. Capscrew
2. Closure	11. Key	20. Thrust Washer
3. Gasket	12. Drive Pin	21. Bearing Retainer
4. Body Stud	13. Gasket	22. Bearing
5. Body Nut	14. Body Cover	23. Dowel Pin
6. Ball	15. Gasket	
7. Seat Ring	16. Capscrew	
8. Seat Spring	17. Bushing	
9. Gasket	18. Adapter Flange	

The valve is designed for use with various material combinations dependent upon customer service conditions.



The AST top entry ball valve is constructed to allow field service and maintenance whenever required.

The body of the AST top entry ball valve is made of cast and/or forged materials and engineered for heavy duty, maintenance-free performance. The forged design is typically used for small size, high pressure valves and critical applications where the integrity of the pressure envelope is of paramount importance.

The valve body is designed and manufactured in accordance with International Standards. Finite Element tools are used to design and verify the components and the valve assembly.

The valve body end connections can be of flanged, welded or clamp types. Considering the in line maintainability of the top entry design it is recommended the use of welded ends to reduce potential leak paths and save valve weight in applications where the weight of the equipment significantly impacts on the installation.

Vent and drain connections are provided on valve body as requested by the applicable International Standards and/or customer specifications.

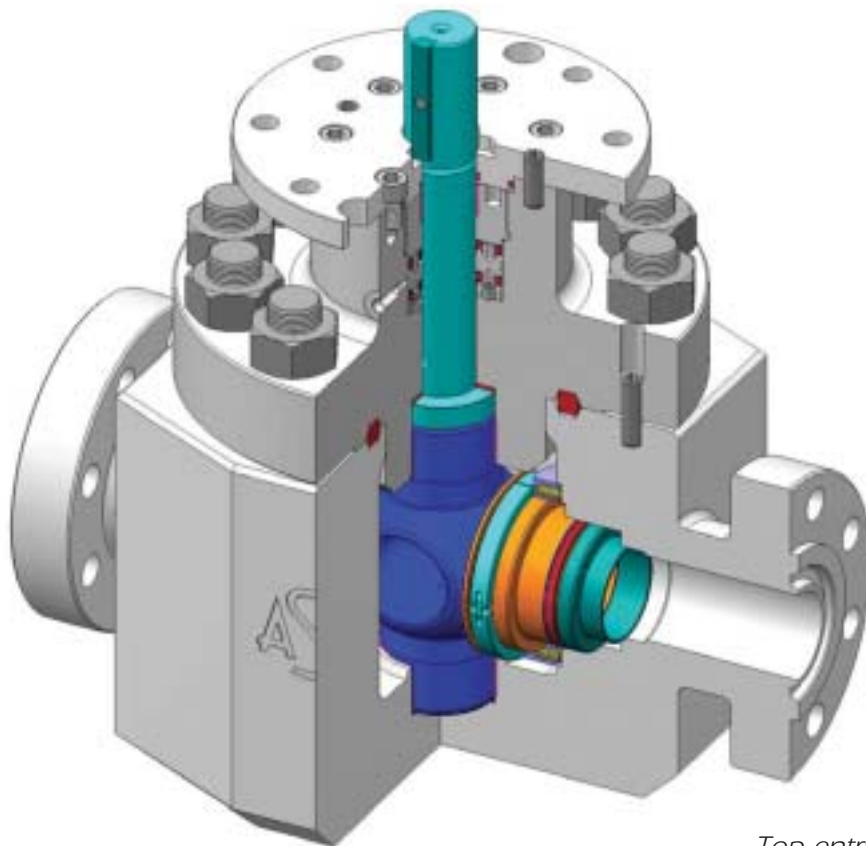
Range of Production

Size: from 6" to 24", full and reduced bore.
Smaller and larger sizes available upon request.

ANSI Rating Class: 600 to 2,500
Class 150 and 300 available upon request with API 6D class 600 end to end dimension

API Pressure Rating: 2,000 to 15,000 psi
Interpolated rating also available.

End connections: Flanged, Butt Weld or Clamp. Other special connections available upon request.

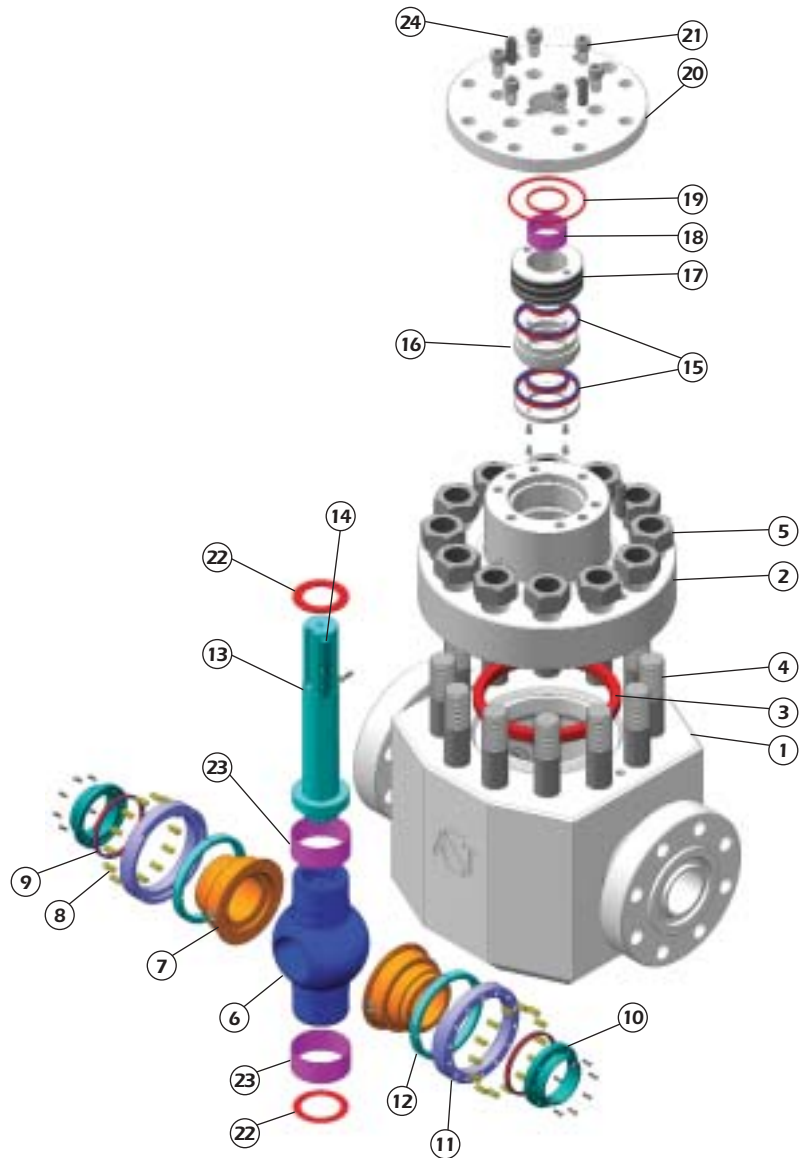


*Top entry design
Forged body*

The removal of the bonnet from the valve allows for free access to the body cavity. A set of maintenance tools is used to remove and re-assemble the ball and the seats. Limited space is required around the valve for maintenance, so that the AST top entry valve can be installed in all areas where space is critical, such as platform decks.

The AST top entry valve can be mounted on vertical pipes with horizontal stem when required by the piping layout such as platform risers. In-situ maintenance is preserved by means of specifically designed maintenance tools.

The integrity of the seat seals can be checked, after valve reassembly, by pressurising the body cavity. If the valve is equipped with bi-directional seats, the test can be done up to the valve design pressure.



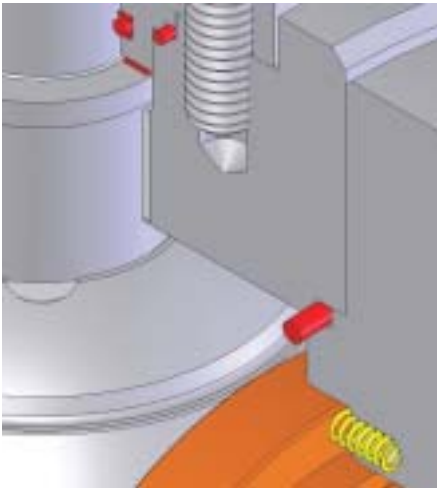
Trunnion Design

1. Body	10. Back Seat Ring	19. Gasket
2. Bonnet	11. Spring Holder Ring	20. Adapter Flange
3. Gasket	12. Spacer	21. Capscrew
4. Body Stud	13. Stem	22. Thrust Washer
5. Body Nut	14. Key	23. Bearing
6. Ball	15. Gasket	24. Dowel Pin
7. Seat Ring	16. Lantern Ring	
8. Seat Spring	17. Bonnet Cover	
9. Gasket	18. Bushing	

The valve is designed for use with various material combinations dependent upon customer service conditions.

Static Seals

Sealing to the environment is achieved by means of elastomeric O-rings fitted as face seal between the two components. AST adopts, on its standard design, this type of seal configuration which is deemed to be more reliable as the initial gasket compression is not influenced by parts deflection due to the applied loads.



The selection of the elastomer is based on valve service condition.

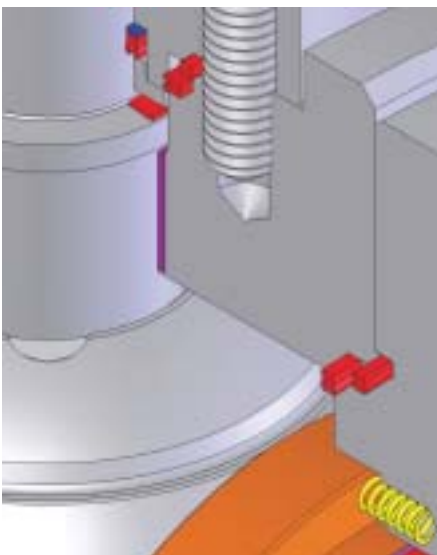
Materials resistant to explosive decomposition (E.D.) are always used for valves in hydrocarbon gas service at pressure class 600 or above.

Special attention is also paid to the design of the gasket grooves to minimise the risk of E.D.

In case of corrosive service conditions or design temperatures exceeding the elastomer limits, spring-energized seals are used. Also in this case the gaskets are preferably installed as face seals to guarantee the most reliable performance.

The materials of the seal jacket and of the spring are selected considering the valve service condition.

Special gaskets can be engineered, and verified by means of Finite Element analysis, to meet the more demanding service conditions including high pressure, high temperature and bi-directional sealing.



Additional seals can be provided, upon request, by means of graphite rings installed as secondary gaskets downstream of the main seals.

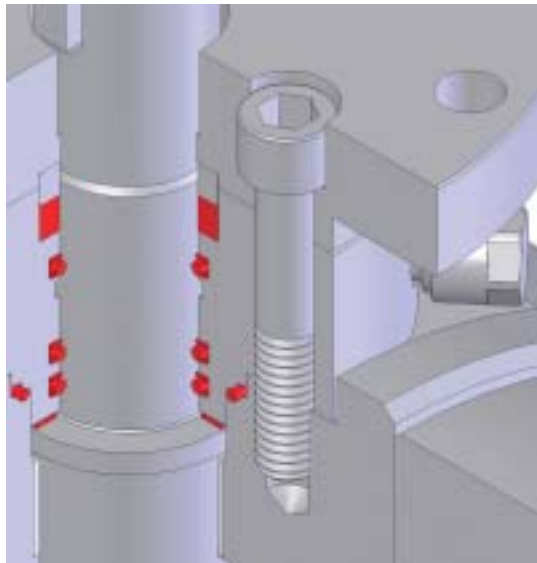
Stem Construction

The stem is of anti-blow-out design, separate from the ball and connected to the upper trunnion by means of pins or by a tang-type connection.

The connection between the stem and the actuator is achieved by means of a key or through a spline.

The stem, together with all the components of the drive train, is sized considering, as a minimum, two times the maximum required valve torque. An additional verification is done considering the maximum torque provided by the selected actuator.

The stem sealing is provided by two gaskets: their selection is based on service conditions likewise all the other seals.



A grease injection port can be provided between the two gaskets allowing the injection of sealant to achieve a temporary sealing.

The stem design allows to replace the upper gasket with the valve in the line, under pressure with the ball in the closed position. With no pressure in line, it is possible to remove the body cover and replace all gaskets.

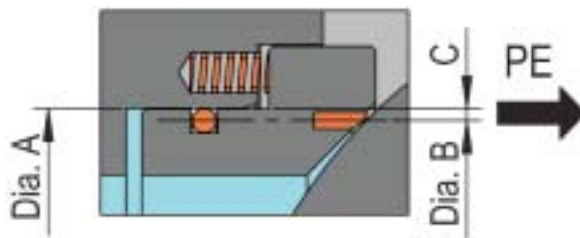
Seat Seals

Side entry and top entry ball valves can be supplied with both seats uni-directional, both seats bi-directional or a combination of the two. The uni-directional seat design, commonly known as “Self Relieving” or “Single Piston Effect”, guarantees the sealing against the pressure coming from the upstream side of the valve.

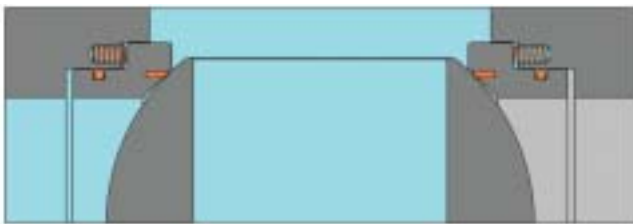


*Uni-directional seat
Upstream sealing*

As the line pressure increases, the pressure acting on the annular area $C = A - B$ (where A and B are the areas corresponding to diameters A and B respectively) creates a piston effect (PE) which forces the seat against the ball: the higher the line pressure, the greater the piston force.



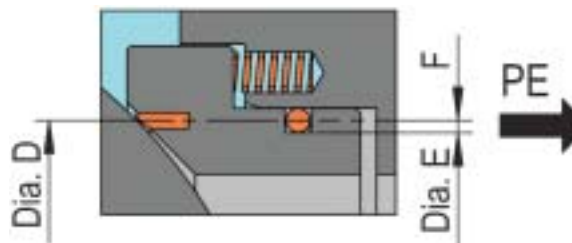
The piston action reverses automatically if pressure in the body cavity grows above a certain level, relieving the excess of pressure into the line.



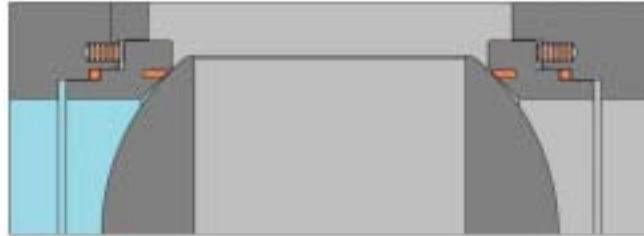
*Uni-directional seat
Self relieving condition*

The seat is designed in such a way that the pressure acting on the annular area $F = D - E$ (where D and E are the areas corresponding to diameters D and E respectively) results in a force greater than the spring load.

In conclusion, this design prevents pressure build-up in the body cavity in case of fluid expansion, by releasing the pressure into the line.

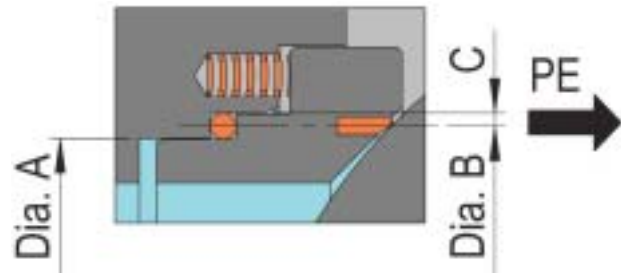


The bi-directional seat design, known as “Double Piston Effect” design, provides sealing in both flow directions.



*Bi-directional seat
Upstream sealing*

Like for the uni-directional seat design (Self Relieving seat), as soon as the line pressure increases, the pressure acting on the annular area $C = A - B$ (where A and B are the areas corresponding to diameters A and B respectively) creates a piston effect (PE) which forces the seat against the ball: the higher the line pressure, the greater the piston force.

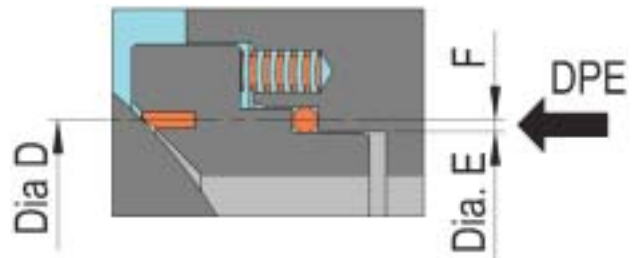


In case of leakage of the upstream seat, the pressure increases in the body cavity energizing the downstream seat which is designed in such a way that the pressure acting on the area $F = D - E$ (where D and E are the areas corresponding to diameters D and E respectively) creates a piston force (double piston effect DPE) forcing the downstream seat to seal against the ball.



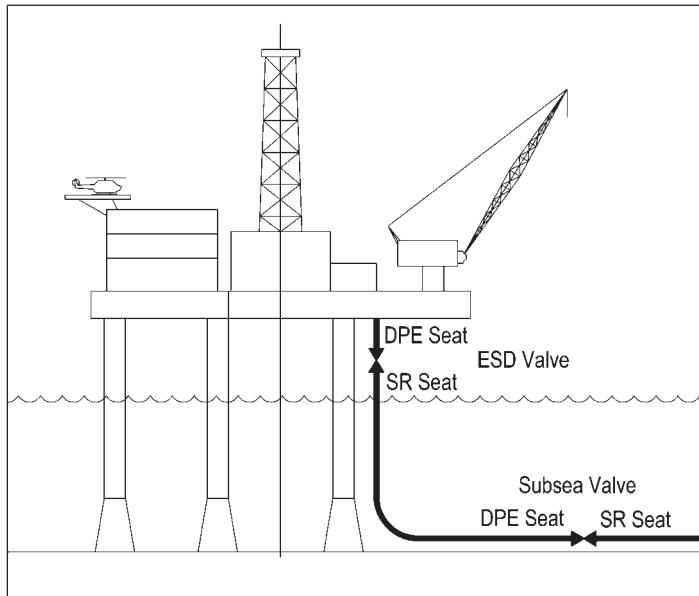
*Bi-directional seat
Downstream sealing*

In conclusion, if one seat is damaged, the pressure in the body cavity will activate the downstream seat to seal. For liquid applications, a possible pressure increase in the body cavity needs to be relieved by means of a pressure relieve valve.

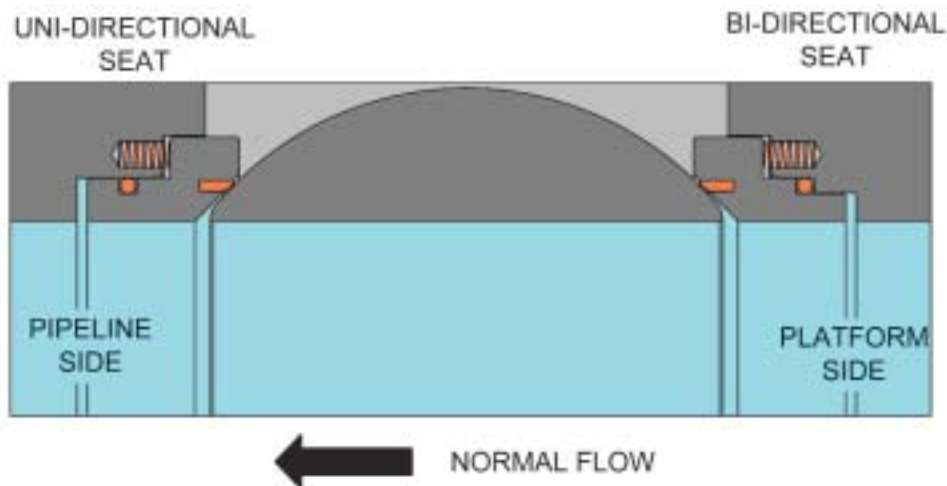


A combination of the two solutions, commonly known as “Dual Seat” design, can be supplied upon request. The rationale behind this design is the need to protect the most critical area of the installation with a double barrier, retaining the possibility to relieve excessive pressure inside the pipeline with no need for external relieving system.

A typical application for the dual seat design is shown in the figure below.

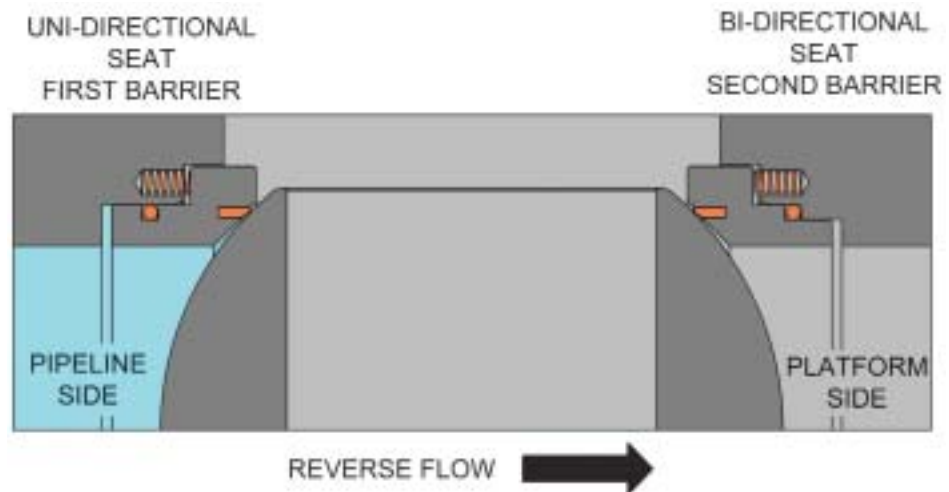


The ball valves, installed on the export line, are equipped with a uni-directional seat and a bi-directional seat accommodated on the pipeline and the platform side respectively.



This seat configuration provides a single barrier against normal flow condition and a double barrier against reverse flow coming from the downstream pipeline.

Under emergency condition a double barrier will isolate the platform from the gas inventory stored in the pipeline.



The body cavity pressure increase, due to thermal expansion of the process media, will therefore be released through the seat located on the pipeline side (downstream) of the valve.

Seating Surface Design

The valve sealing is provided through a metal seat ring which is sealing against the ball by means of a resilient insert and against the body by a seat gasket.

The seat ring is forced against the ball by springs; the load generated by them keeps the seat in contact with the ball and initiates the sealing at low pressure when the piston force is not yet effective.

The seat gasket, located in the back shoulder of the seat ring provides sealing against line pressure.

Different seat gasket design arrangements are available providing the uni-directional or the bi-directional seat configurations as explained in the relevant section. The seat gasket material selection is based on valve service conditions just like for all the other seals.

The spherical surface of the ball is machined and ground to close tolerances. To minimize wear, the ball is then electroless nickel plated and polished to mirror-like finish.

For special applications the contact area between the seat and the ball can be completely metallic. This solution is recommended when the normal soft sealing is not suitable due to the severity of the service condition and to the presence of solid particles that may damage the seat insert.

In case of metal to metal design, the ball and the seat contact surfaces are hard faced with tungsten carbide coating or chromium carbide coating to improve resistance to wear and prevent scratching caused by the solid particles contained in the process media.

When utilizing the metal to metal design option, the valve operating torque, the drive train design and the actuator sizing must be reviewed since a higher valve torque is foreseen.

Stem/Ball Position

The valve are normally supplied with gears or actuators with their mechanical stops set at the factory as primary stops to guarantee perfect alignment of the ball bore with respect to the pipeline avoiding any problem during pigging operations.

For lever operated valves, the valve is in the fully open position when the lever is in line with the valve.

Open and closed indication is provided on valve or gear/actuator.

Antistatic Device

The electrical continuity between the ball and the valve body and between the stem and the valve body is guaranteed by an antistatic device.

Material Selection

The material selection for the valve components is based on the specified service condition. The sizing of the pressure envelope, as well as the sizing of the drive train, is based on the mechanical properties of the selected materials.

Specific guidelines are followed to define the elastomer properties and the groove geometry in case of O-Rings exposed to the risk of Explosive Decompression.

An ongoing research programme with local Universities and coating suppliers allows to offer the most advanced types of metallic coatings for metal seated valves. Future developments in this field include the use of nanomaterials to improve coating quality and surface finishing with possible reduction of the friction factor resulting in a lower torque required to operate the valve.

Weld Overlays

Sealing areas and other critical parts of the valve can be cladded in case of corrosive service. This prevents corrosion in the sealing areas and keeps unchanged the finishing of the surface in contact with the gasket thus retaining the original sealing functionality.

More frequently used materials for the overlay process are Stainless Steel and High Nickel Alloys, thanks to their unquestioned corrosion resistance properties.

The welding process is qualified according to International Standards so that the final thickness after machining can guarantee the chemical composition as per the relevant ASTM standards or per customer specifications.

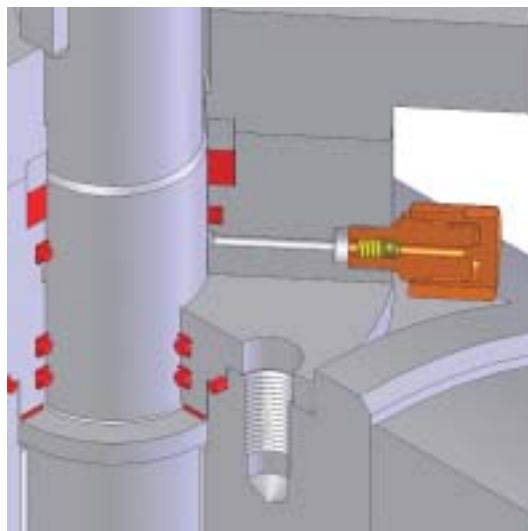
The final check of the overlay is carried out by Dye Penetrant Inspection to verify surface integrity and Ultrasonic Examination to confirm overlay integrity and proper adhesion between the two materials.

Stem Grease Injection

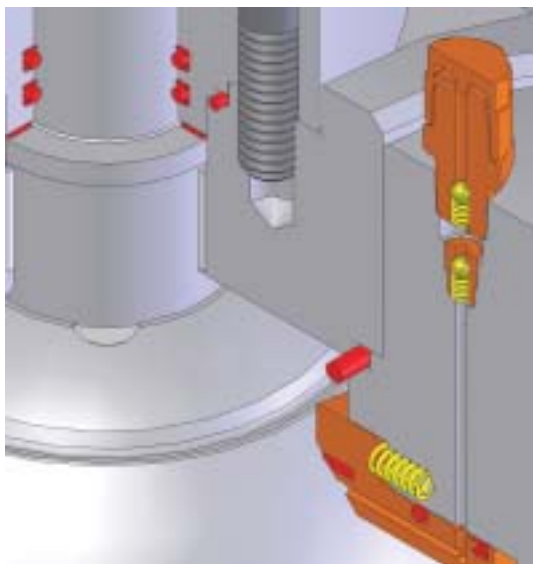
Upon request, an emergency stem sealant injection point can be provided between the second and the third gasket to temporarily seal the stem until the primary seal is restored.

The grease fitting incorporates a check valve designed to prevent leakage to the environment, still allowing grease injection.

Note: sealant is not required in normal operation.



Seat Grease Injection



Upon request, valve seats can be equipped with a sealant injection system to provide emergency sealing between seat and ball.

The injection system comprises the grease fitting with the relevant sealing cover and the integral check valve.

An additional check valve is fitted in the main valve body thickness in order to provide a second barrier to fluid leakage.

The system is designed to allow sealant grease injection into the valve in service; the sealant is distributed on the seating surface between seat and ball.

Note: sealant is not required in normal operation.

The seat grease injection system is recommended for soft seated valves while is redundant in case of metal seated valves where the risk of damaging the seating surface is less likely thanks to the hardness of the surfaces.

Monitoring Leak Ports

Upon customer request, ports can be provided to monitor the performance of critical gaskets like stem and body to bonnet sealing.

Transition Pieces

Should transition pieces be required, AST is fully capable to machine and weld on transition pieces during the manufacturing of the valve.

The transition pieces may be supplied by AST or free issued by the customer. The transition pipe, when supplied by AST, will be fully compatible with the line pipe and will be welded using a process fully qualified in accordance to International Standards.

Stem Extension

Stem extension can be provided making the valve suitable for inaccessible areas or buried service.

The piping of the grease injection system and of the vent and drain connections are extended to the top of the extension to ease their access.

Installation on a Vertical Line

The top entry valve can be supplied for installation on vertical pipelines. This type of piping configuration is frequently used in case of platform risers.

The in-situ maintenance is possible thanks to special maintenance tools that are designed and supplied with the valve. The special maintenance equipment permits to remove and reinstall ball and seats while being supported during such operations.

The clearance needed for valve maintenance is fully encompassed within the overall dimension of valve and actuator.

AST engineering department is available to collaborate with customer since the early stage of the Project to define the lifting equipment to be provided on the installation to handle with heavy valve parts.



Internal Sleeve

Under severe commissioning conditions, AST can supply top entry valves with low cost temporary sleeves.

The temporary sleeves are designed to protect body sealing surfaces and create a full port through the valves to ease the pigging operation.

After final acceptance tests, valve internals are removed from the valve, preserved, packed and shipped to site, while the temporary sleeve is installed into the valve body.

The valve body/bonnet unit is then pressure tested again to verify seal integrity before being shipped to site.

Valve internals are installed back into the valve body after the system has been fully commissioned.

In case the valve is equipped with bi-directional seats, the integrity of the seat seals can be tested by pressurising the body cavity.

Over the years, AST has enjoyed the recognition of designing and manufacturing special relief valves and special control valves for severe service. This has been possible thanks to the continuous investment in R&D and in the human resources of the engineering department.

The addition of new product lines to the AST product portfolio is achieved in conjunction with the recruitment of highly motivated and experienced people that will constitute the new products team.

For the new products, AST is committed to become the preferred supplier for special, critical, heavy duty valves, partnering with the customers to identify the most reliable and cost effective solution for their service conditions.

For any application not addressed here, the AST engineering department is available to assist customers and to propose the most appropriate technical solution

Subsea

For both side entry and top entry ball valves, a subsea version specifically designed to suit subsea service conditions is available.

The design applies more restrictive criteria for the definition of the safety coefficients relative to both pressure retaining components and drive train, making the valve suitable for SSI and ESD services.

The valve internal sealing surfaces are protected from corrosion by welding overlays. The ball/seat sealing surfaces are hard faced to reduce wear and preventing operating torque increase due to sticking experienced by soft seated valves when not operated for long time periods.

The valve body can be coated with special coatings. All external bolting are protected with ad-hoc protective coatings as well as special sealing caps.

The stem and all external sealing areas are protected with additional seawater sealing gaskets.

A stem protective cap is provided to prevent ingress of seawater and allows for deployment of either gear or actuator when required. Special guide posts can be provided to ease gear/actuator removal or installation even when the valve is installed in tilted position.

Low Temperature

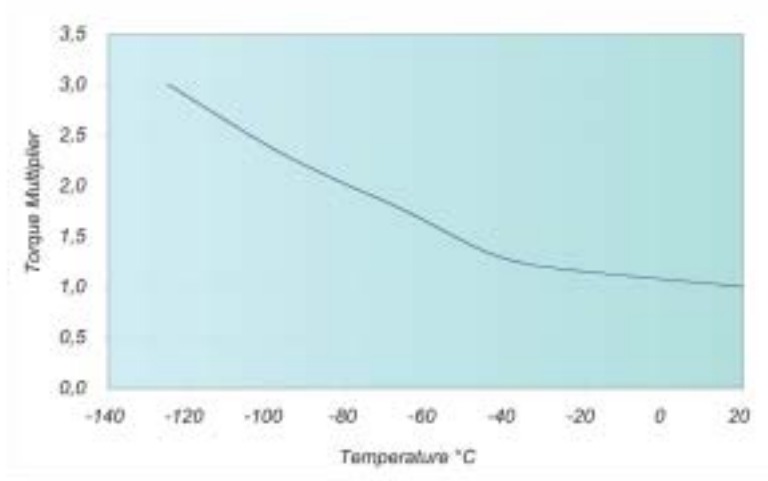
The low temperature design is available for both side entry and top entry valves. This design is suitable for temperatures down to $-140\text{ }^{\circ}\text{C}$ in all class ratings.

The valves are supplied with an extended bonnet thus allowing the installation of the thermal insulation and to move the stem seal away from the low temperature area, thus enhancing the stem seals performance.

The valves are fitted with special spring-energised gaskets specifically designed to seal at low temperature.

The sealing between seat and ball can be provided by special insert materials suitable for low temperature service or can be of hard faced metal to metal type.

The material selection for the metallic parts is based on valve service condition with specific regard to corrosion resistance and temperature requirements.



Low temperature torque increase (typical)

Whereas valve torque increases at low temperature, as a function of differential pressure and operating temperature, to specify maximum differential pressure at lower temperature at which the valve will be operated avoids to over-size valve and actuator.

High Temperature

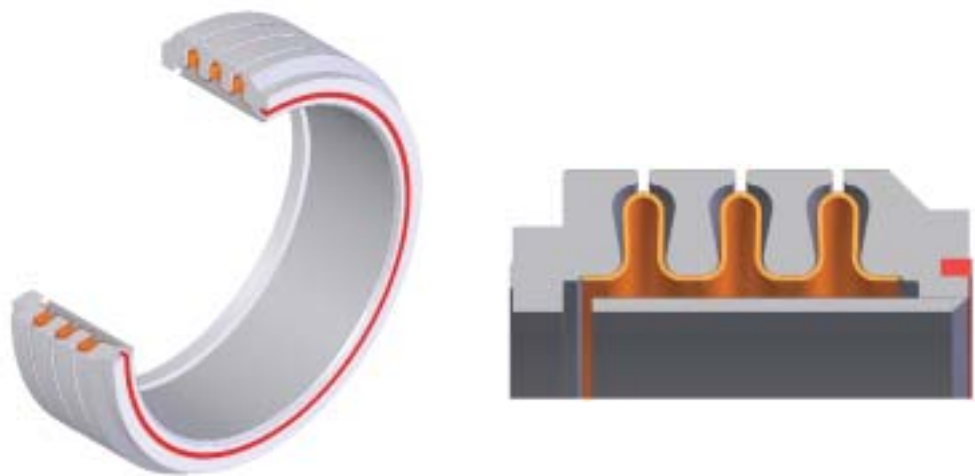
The high temperature version of the side entry and top entry ball valves is designed for operating temperatures up to 400 °C in all pressure classes.

The valves are suitable for heavy cycling under alternating conditions of temperatures and pressures.

At difference with other valve types usually chosen for high temperature service, i.e. the rising stem valves, the AST high temperature ball valve is fully bi-directional at maximum differential pressure.

The drive train is designed taking in consideration the high torque values resulting from the demanding service conditions.

The valve is fitted with gaskets specifically designed to withstand high temperature, whereas metallic contact is adopted for the seat to ball sealing. Both sealing surfaces are hard faced by means of a special ENP process and then heat treated at high temperature, or by chromium carbide applied by HVOF process.



Bellow Seal

The ball to body sealing is achieved through a bellow-type seat which provides the metal sealing against the back face of the seat, and through a soft ring between bellow seat and valve body.

The bellow seat is designed to develop a piston effect forcing the seat against the ball: the higher the line pressure, the greater the piston force. The piston action reverses if pressure increases in the body cavity to a preset level, relieving the excess of pressure into the line and protecting the bellow seal from external pressure load.



Double Block and Bleed

AST designs, manufactures and supplies Double Block and Bleed valve units.

One compact forged body contains the two block valves and the bleeding system achieved by ball, gate or needle valves as per customer specifications.

This design arrangement allows to reduce clearance and weight, meanwhile the number of external leak path are reduced with subsequent enhancement of the system reliability.

Retractable Seats

Pipeline pigging is recognised as one of the most critical operation as far as valves integrity. The debris collected by the pig during its travel can be trapped in the recesses between ball and seats damaging the sealing surfaces when the valves are later on operated.

To prevent this risk, AST can supply ball valves with retractable seats. The seats are detached from the ball prior to start rotating the ball, thus avoiding debris retention between ball and seats.

The seats retraction is automatically achieved through the actuator control system with no need for the valve operator to make additional operations.

The actuator is still sized for the max valve torque without taking into consideration the benefits deriving from the absence of friction between ball and seats.

In the unlikely event of a failure of the hydraulic seat retraction system, the valve continues to be operable as a standard ball valve.

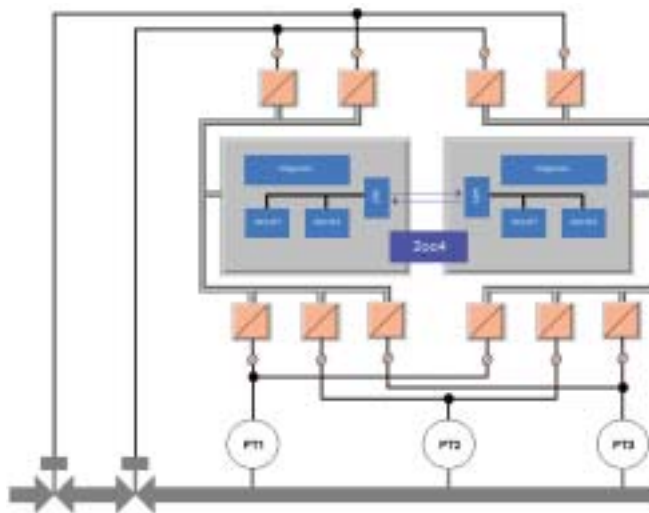
High Integrity Pressure Protection System (HIPPS)

The High Integrity Pressure Protection System is designed to protect a downstream trunk line from overpressure. The system closes the flow line shut down valve in case high pressure detected at a pressure detection points.

After shut down, once the correct pressure has been restored, the system is reset and normal operation can be restarted.

The HIPPS closed loop system mainly consists in the on/off valves, the pressure transmitters, the instrument manifolds and the PES (Programmable Electronic System) as Logic Solver.

HIPPS, as well as all the equipment inside the loop, meets requirements up to SIL3 (Safety Integrity Level 3) according to IEC 61508 and AK6 according to DIN V 19250 .



To ensure the maximum safety, fault tolerance and availability, the Logic Solver has a redundant 2oo4D/QMR architecture (2 out of 4 processors, quad modular redundant) .

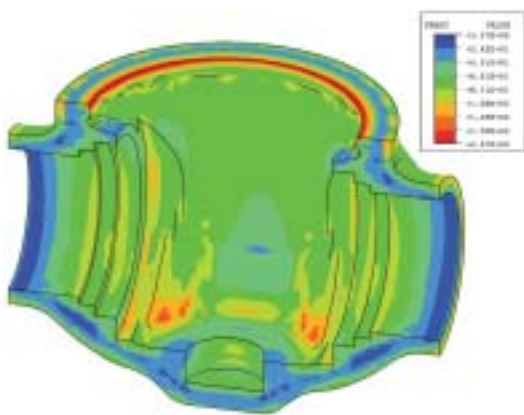
Operation can continue without any time limit even in case of the first error in the system, because PES meets SIL3 also if only one processor is running .

AST has the in houseware resources and skill to design, to manufacture and to supply the HIPPS thanks to their knowledge in both valve and instrumentation fields. This is made possible by joining the resources available at the AST engineering department and the long term experience of the sister company in the field of process automation and safety systems, emergency shut-down systems above all.

This organization and collaboration allows AST, with a unique comprehensive experience encompassing valve and fail safe systems design, to be a supplier of HIPPS, as integrated solution .

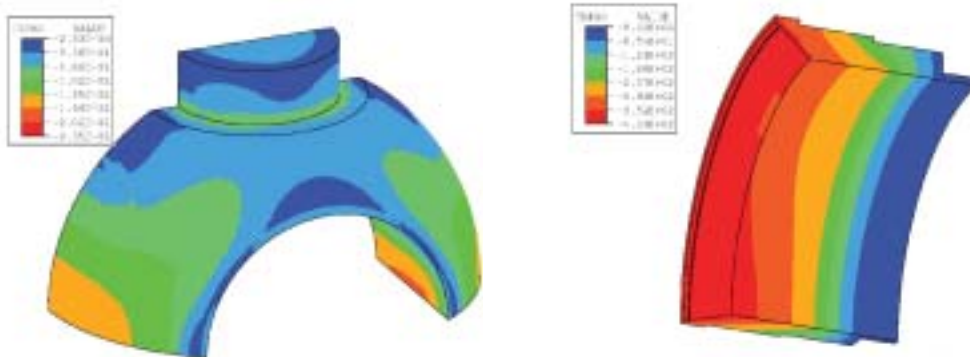
Engineering

AST engineering department operates with the most advanced computer aided systems.



Top entry body stress distribution

Prediction by Finite Element analysis of stress levels and deflection is part of our standard procedures. This may include non-linear analyses of large valve bodies, with the simulation of the behaviour of all seals in all operating conditions.



Non-linear FEA of ball to seat contact

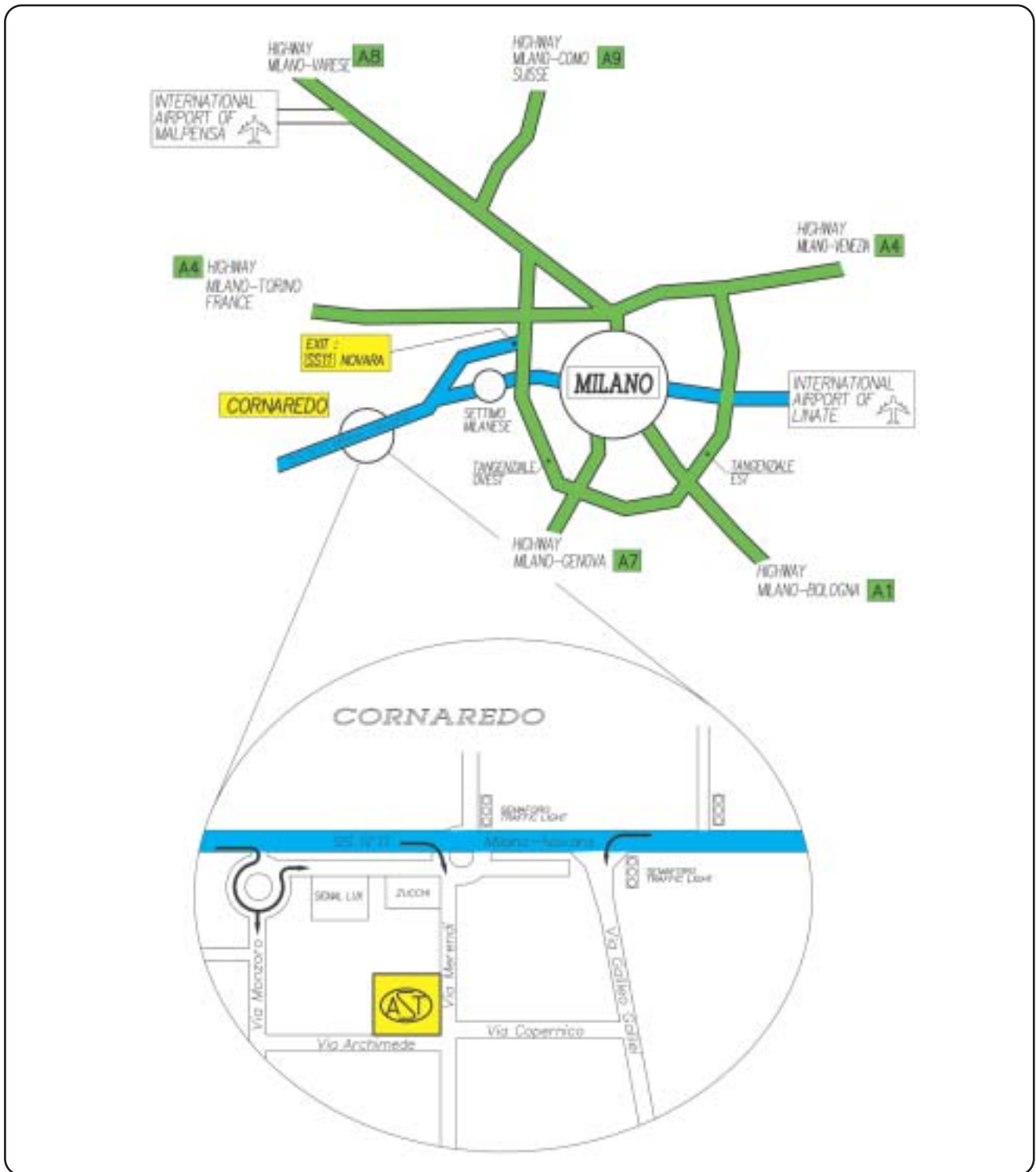
Qualification Tests

All valves are pressure tested in accordance to relevant standards and specifications. Particular care is given to the validation of valve production; new products undergo extensive performance and qualification tests. The qualification test is meant to ensure that the design safety factors, the maximum allowable leakages and the expected valve service life are achieved.

Since the conventional hydrostatic testing of valves for gas service is no longer regarded as a sufficient mean to demonstrate the valve sealing integrity, AST is equipped to carry out enhanced gas testing at ambient, low and high temperature.

Stress verification can be carried out by strain gauges to verify the stress distribution predicted by numerical analysis.

In collaboration with the sister company AST S.r.l., extensive functional tests are carried out, to possibly verify the performance of the complete HIPPS.



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