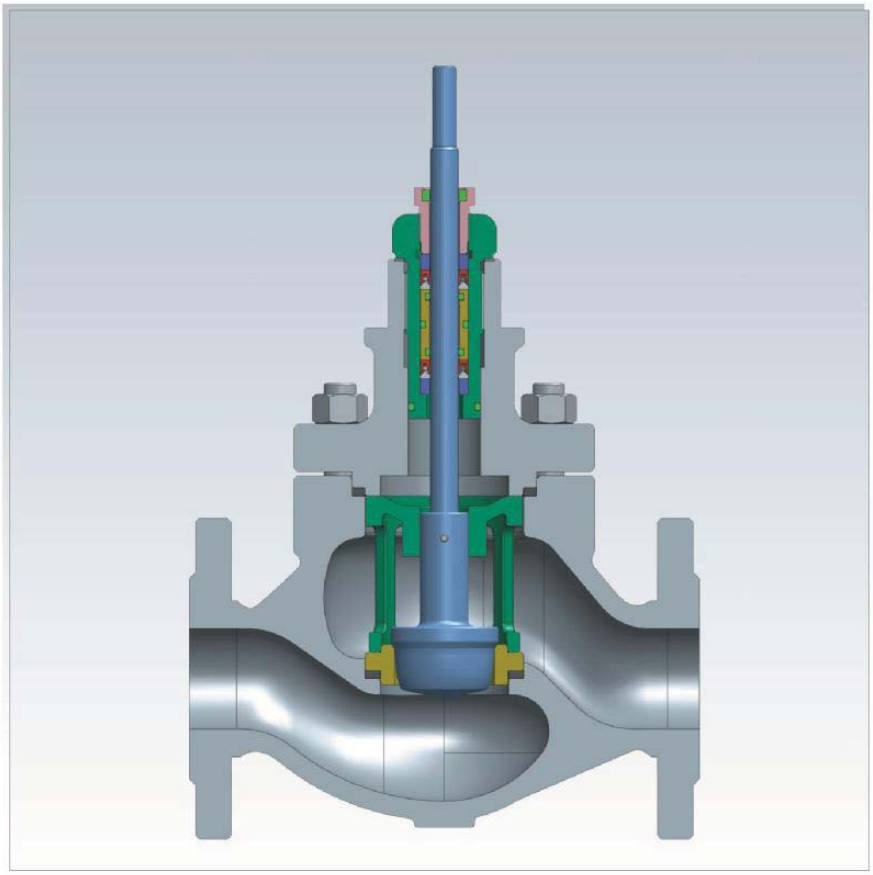
DAGO

▶ 10P Series control valve



▲ Outline

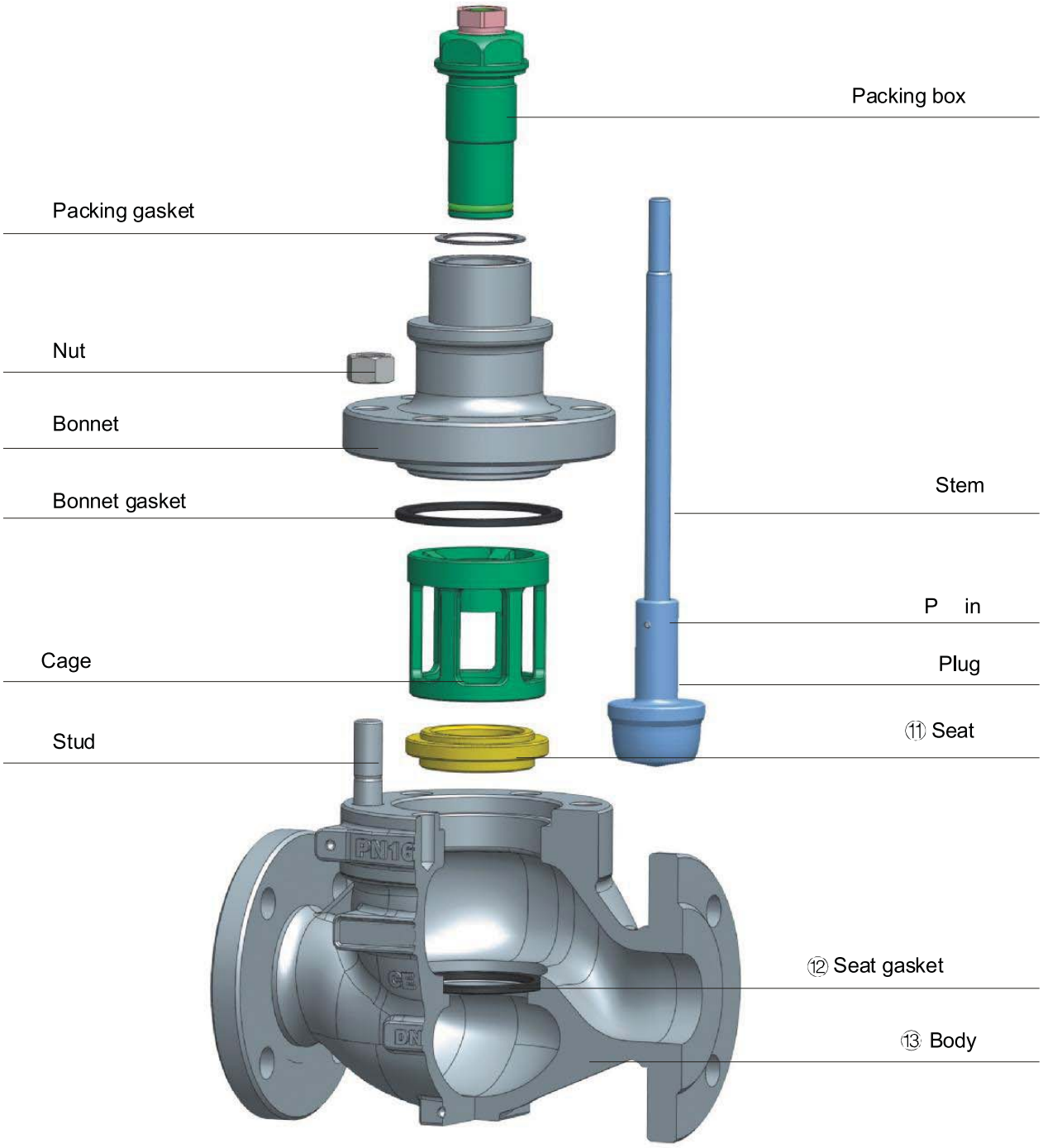
The 10P Series single-seat control valve adopts the top guided unbalanced structure, featured by high strength, heavy load, S type flow channel, low pressure drop loss, high flow coefficient, wide adjustable range, high flow characteristic precision, etc.
This kind of control valve is suitable for applications with relatively low differential pressure with tight shut-off. It is suitable for controlling medium flow or pressure. The cage adopts the press-in type seat design, which solves the problems of difficult disassembly and high leakage of the traditional thread screw-in type seat and prolongs the service life. The flow to open design is adopted, and the medium flow direction tends to the opening direction of the valve with good controllability of small opening and low flow characteristic distortion. Special cages with noise reduction and anti-cavitation functions can be offered according to the requirements in different service conditions.

▲ Parameters of control valves:

Trim features:	Top guided, unbalanced trim, quick disassembly cage structure
Body type:	straight-through type, angle type.
Bonnet type:	standard type, heat dissipation type, cryogenic type, bellows
Flow characteristic:	equal percentage, linear, quick open
Shut-off class:	ASME B16.104 V (standard metal seat) ASME B16.104 VI (shut-off soft seat)
Pipe connection type:	flange type, butt welding type
Applicable temperature range:	-196 - 570
Actuator type:	pneumatic diaphragm actuator pneumatic piston actuator Electric actuator

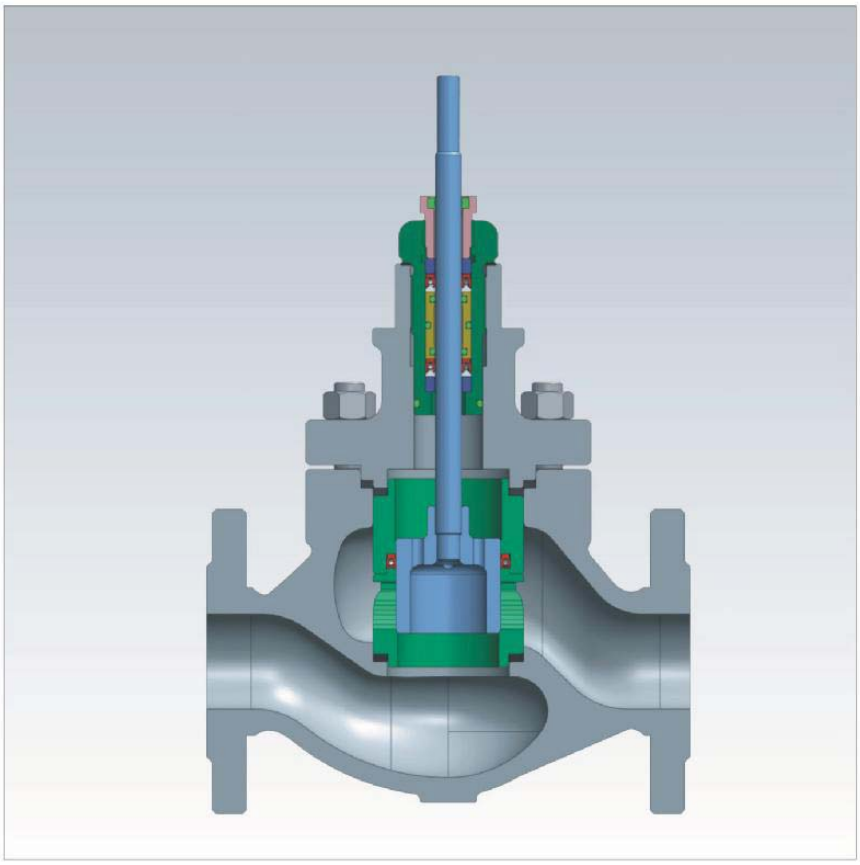
DAGO

▶Exploded view of 10P Series



DAGO

▶10T Series control valve

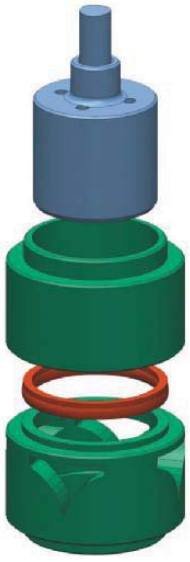


▲ Outline

The 10T Seriescage single-seat control valve adopts the cage guided structure and pressure balanced plug. It is suitable for applications with relatively high differential pressure. The balanced seal ring replaces the upper seat to change the traditional cage double-seat valve structure into the cage single-seat structure. This improvement has greatly enhanced the shut-off class of the cage valve. The plug makes use of the pressure balanced structure, the opening and closing force is low and the media under service conditions with high differential pressure can be controlled through relatively low actuator thrust. It is widely used for fluid control on pipelines of middle and low temperature and middle and low pressure that require good dynamic stability. With such features as good sealing performance, high allowable differential pressure, cage guiding, large guiding area, good stability and compact structure, it can realize fast replacement of trims on the line with high maintenance efficiency, saving manpower and time. The balanced plug structure makes sure that the actuator thrust required is the lowest.

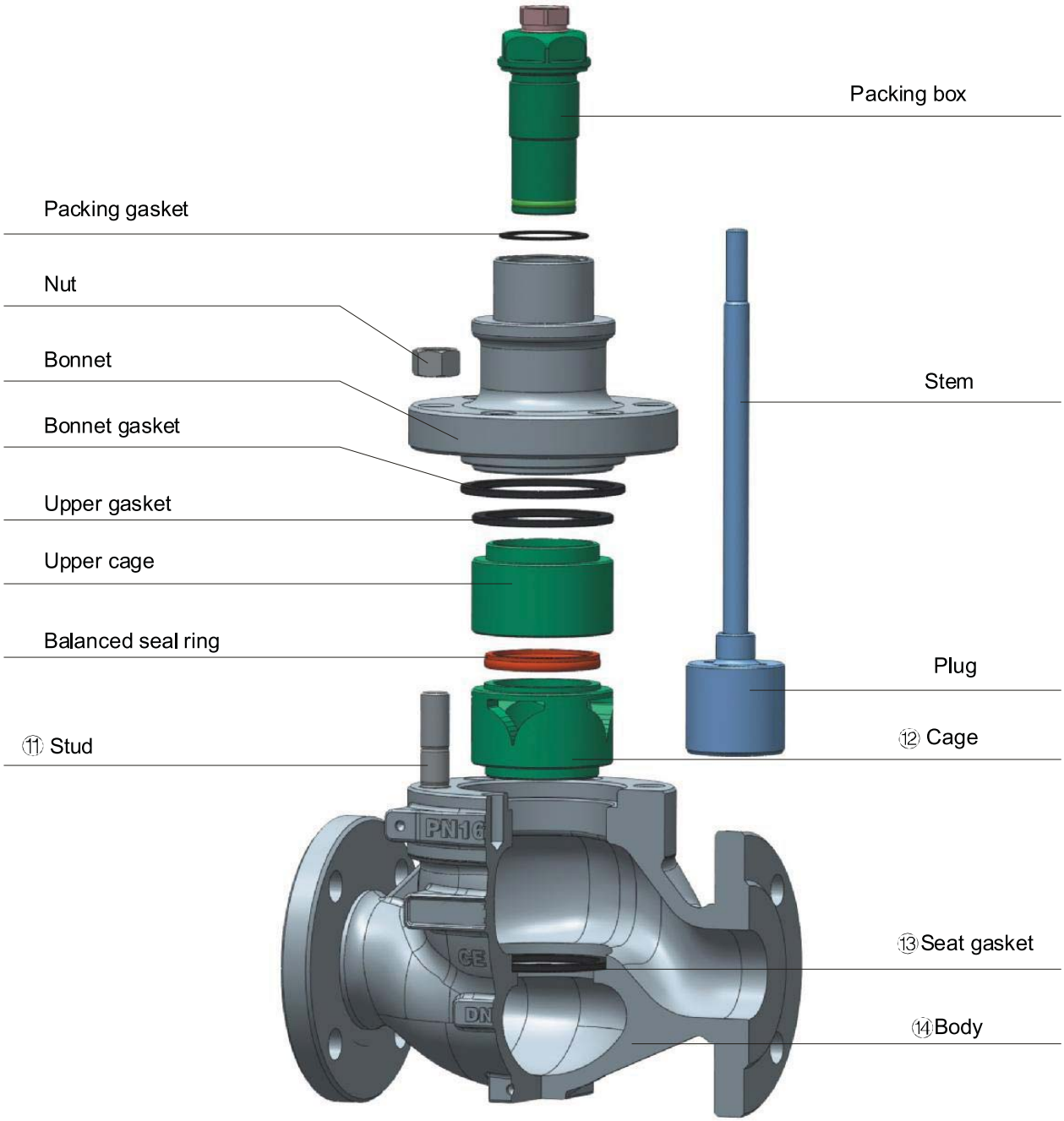
▲ Parameters of control valves:

Trim features:	cage guided type, balanced trim structure, with balanced seal ring structure
Body type:	straight-through type, angle type.
Bonnet type:	standard type, heat dissipation type, cryogenic type, bellows
Flow characteristic:	equal percentage, linear, quick open
Shut-off class:	ASME B16.104 V (standard metal seat) ASME B16.104 VI (shut-off soft seat)
Pipe connection type:	flange type, butt welding type
Applicable temperature range:	-30 - 260
Actuator type:	pneumatic diaphragm actuator pneumatic piston actuator Electric actuator



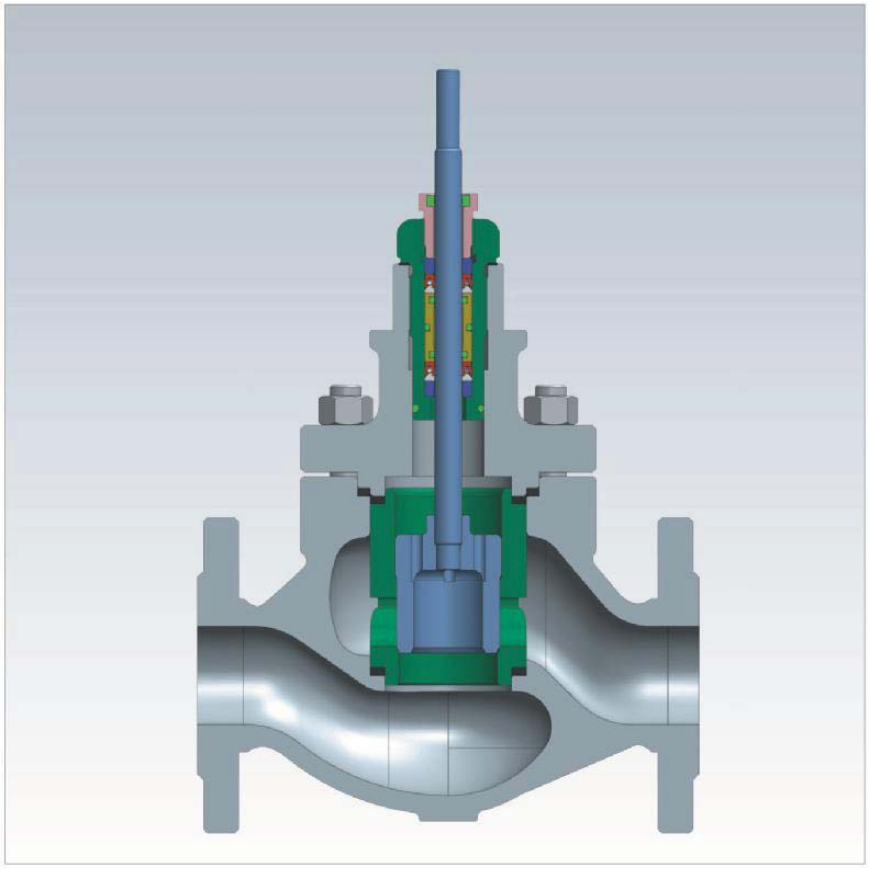
DAGO

Exploded view of 10TSeries



DAGO

10G Series control valve



▲ Outline

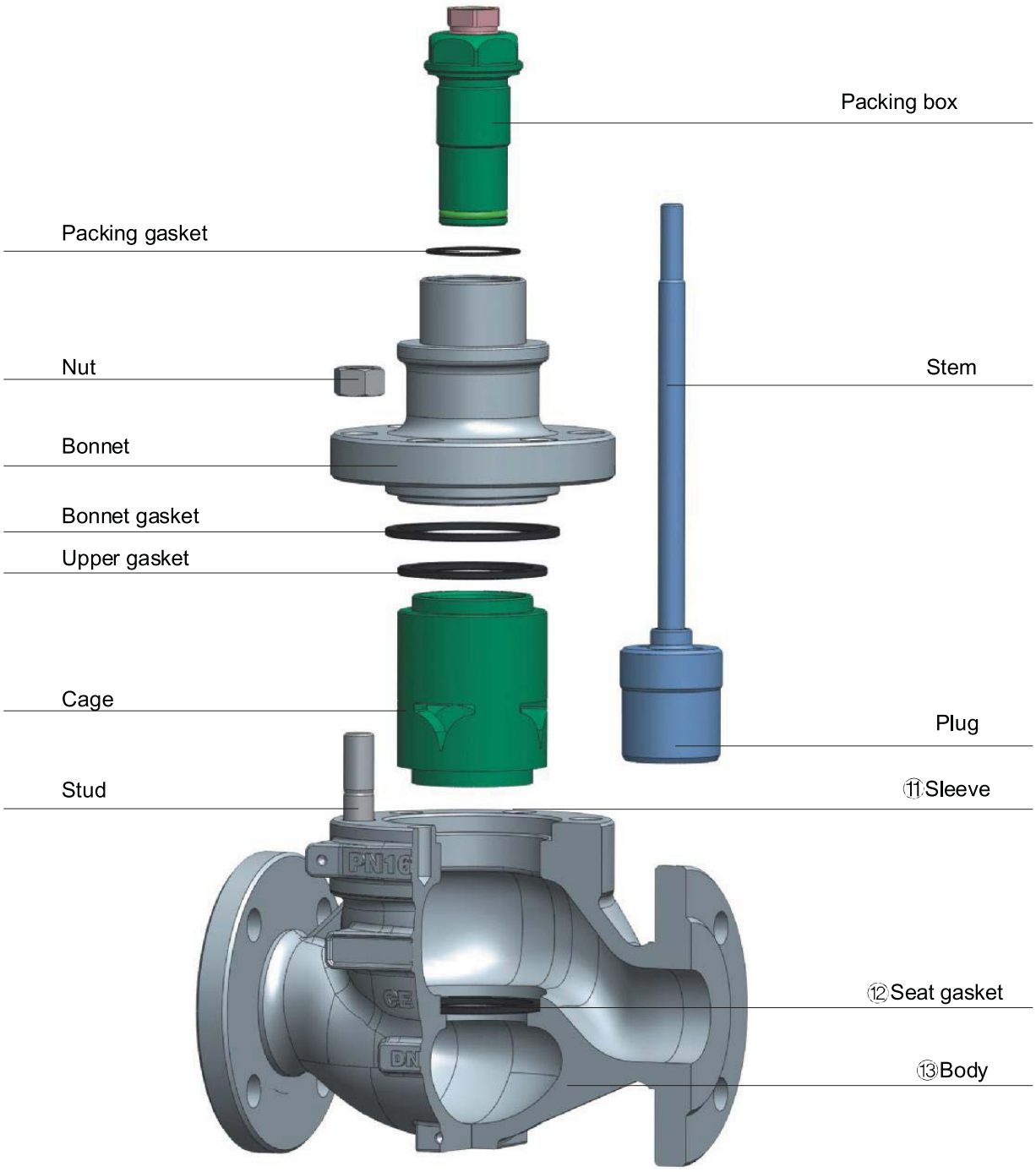
The 10G Series cage double-seat control valve adopts thecageguided structure and pressure balanced plug. Different from the 10T Series, this kind of control valve adopts the cagedouble-seat structure and is mainly used in applications that do not have high requirements for shut-off class. As it adopts the double-seat structure, and the two sealing faces are metal seals, the temperature range is wider. The plug makes use of the pressure balanced structure, the opening and closing force is low and the media under service conditions with high differential pressure can be controlled through relatively low actuator thrust. It is widely used for fluid control on pipelines of middle and low temperature and middle and low pressure that require good dynamic stability. With such features as good sealing performance, high allowable differential pressure, cage guiding, large guiding area, good stability and compact structure, it can realize fast replacement of trims on the line with high maintenance efficiency, saving manpower and time. The balanced plug structure makes sure that the actuator thrust required is the lowest.

▲ Parameters of control valves:

Trim features:	cage guided type, balanced trim structure, with balanced seal ring structure
Body type:	straight-through type, angle type .
Bonnet type:	standard type, heat dissipation type, cryogenic type, bellows
Flow characteristic:	equal percentage, linear, quick open
Shut-off class:	ASME B16.104 V (standard metal seat) ASME B16.104 VI (shut-off soft seat)
Pipe connection type:	flange type, butt welding type
Applicable temperature range:	-196 - 570
Actuator type:	pneumatic diaphragm actuator pneumatic piston actuator Electric actuator

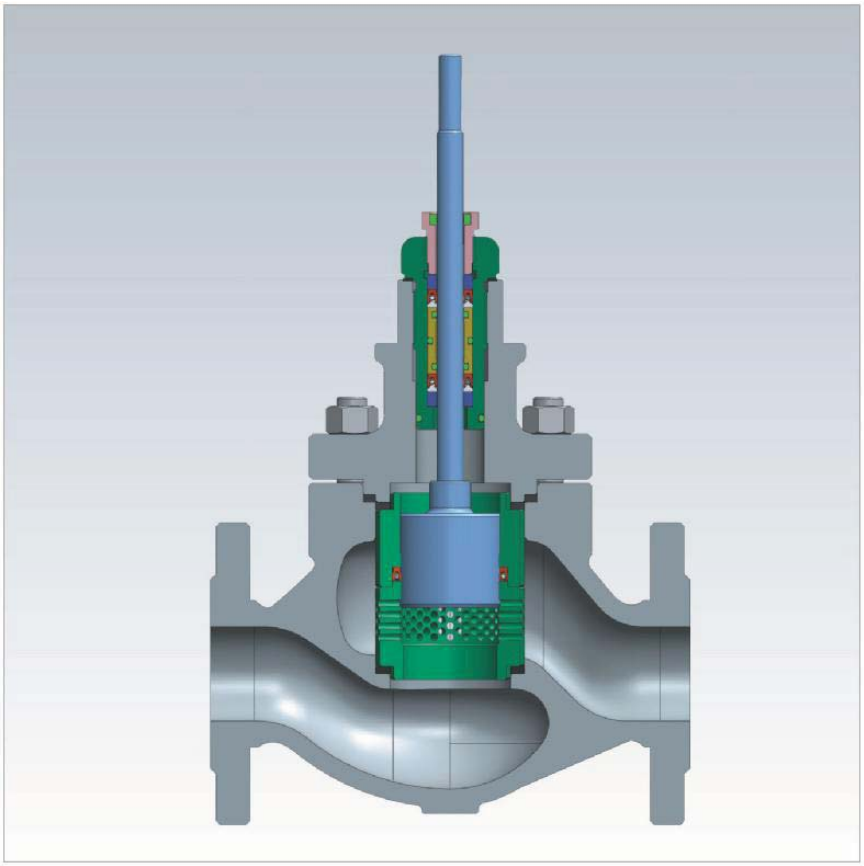
DAGO

▶Exploded view of 10G Series



DAGO

▶10D Series control valve

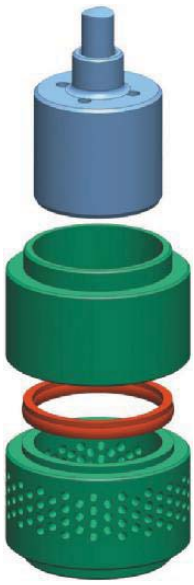


▲ Outline

The 10D Series multi-hole low noise control valve adopts the sleeve guided structure and pressure balanced plug. It is a high performance control valve with good dynamic stability that is suitable for severe service conditions. As the differential pressure in the service conditions is relatively high and the flow velocity of media is high, the trims will be severely eroded and damaged and high noise will be produced. Therefore, we change the standard window-type sleeve into the multi-hole sleeve. For liquids, the flow direction is generally high-in and low-out, and multi-hole throttling makes the media carry out collision inside the sleeve, so as to consume internal energy and reduce flow velocity. For gas media, the flow direction is generally low-in and high-out, so that the gas media achieve volume expansion at the back of the seat after throttling by the multi-hole sleeve and the pressure of media is reduced to lower the flow velocity. The parts of the 101D Series are interchangeable with those of the 101T Series control valve except that the sleeve is changed into the multi-hole type.

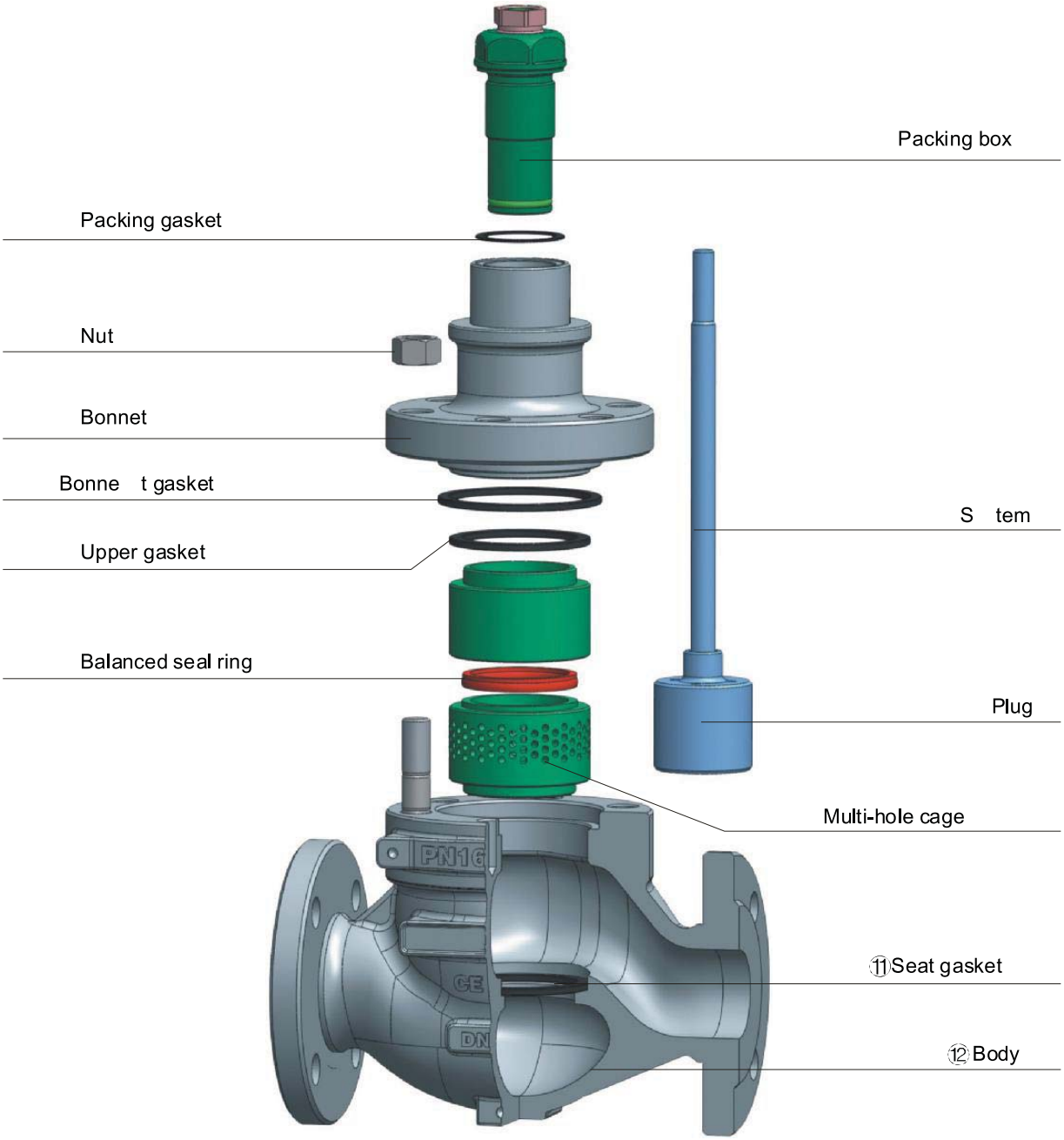
▲ Parameters of control valves:

Trim features:	sleeve guided type, balanced trim structure, with balanced seal ring structure
Body type:	straight-through type, angle type .
Bonnet type:	standard type, heat dissipation type, cryogenic type, bellows
Flow characteristic:	equal percentage, linear, quick open
Shut-off class:	ASME B16.104 V (standard metal seat) ASME B16.104 VI (shut-off soft seat)
Pipe connection type:	flange type, butt welding type
Applicable temperature range:	-30 - 260 (single-seat structure) -196 - 570 (double-seat structure)
Actuator type:	pneumatic diaphragm actuator pneumatic piston actuator Electric actuator



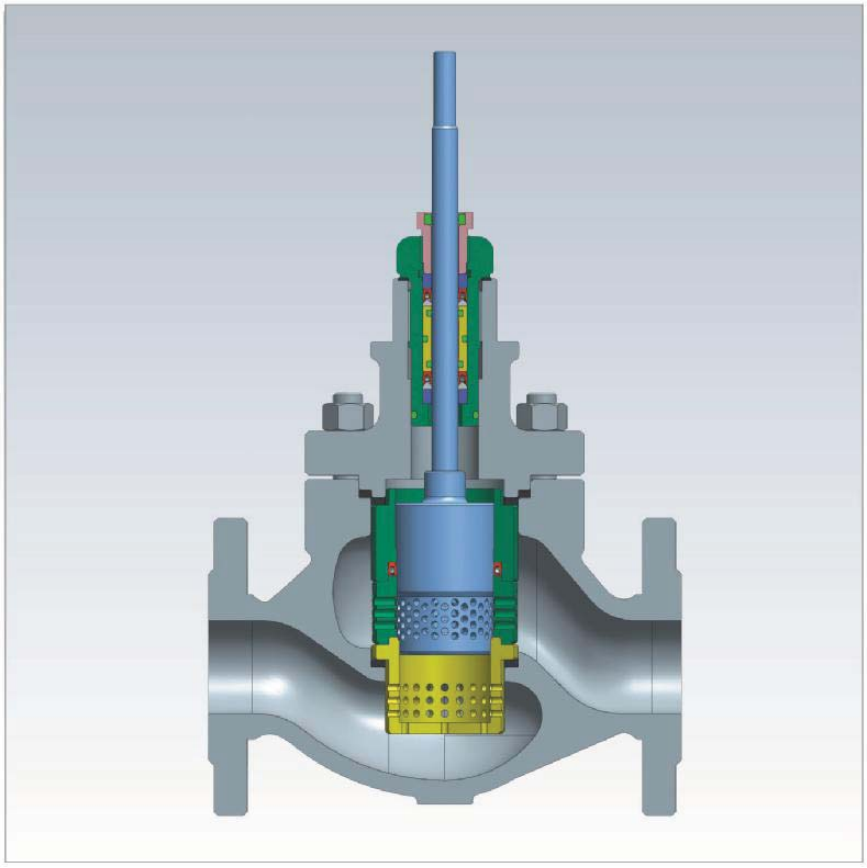
DAGO

▶ Exploded view of 10D Series



DAGO

▶ 10S Series control valve



▲ Outline

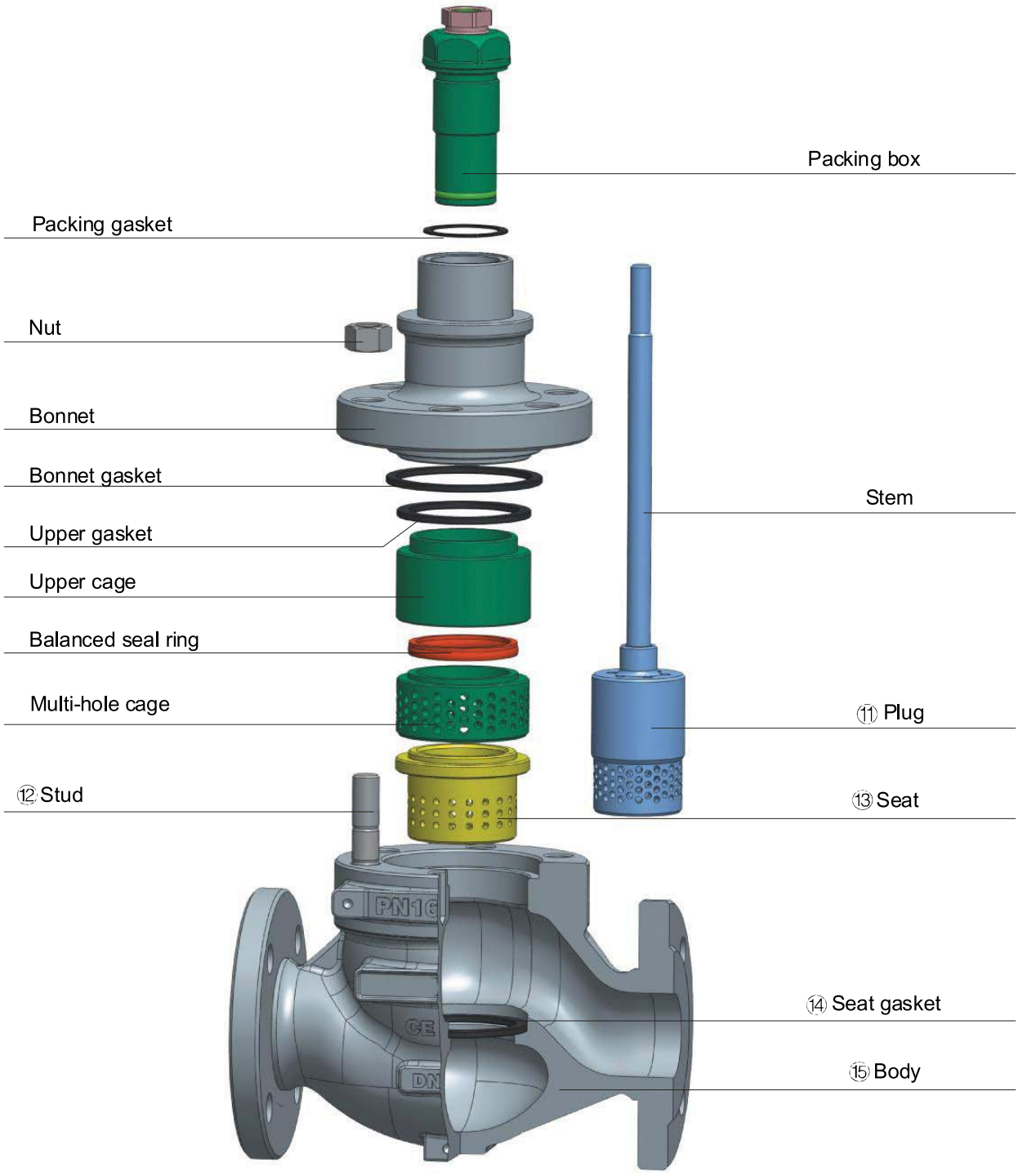
The 10S Series multi-stage pressure drop control valve adopts the sleeve guided structure and pressure balanced plug. It is mainly used in service conditions with high differential pressure and applications that produce flash evaporation and cavitation. According to different parameters, it is designed with different pressure drop cages that form a multi-stage pressure drop trim. The cages designed according to different service conditions ensure the occurrence of flash evaporation and cavitation in the valve is eliminated. Throttling is carried out from the time when the media contact the first cage, and the high differential pressure at the inlet is gradually reduced after several times of throttling. Thus it is effectively ensured that the pressure is always above the saturated vapor pressure when the media flow in the valve, and the occurrence of flash evaporation and cavitation is eliminated, so that the service life of the control valve is prolonged under severe service conditions.

▲ Parameters of control valves:

Trim features:	sleeve guided type, balanced trim structure, with balanced seal ring structure
Body type:	straight-through type, angle type
Bonnet type:	standard type, heat dissipation type, cryogenic type, bellows
Flow characteristic:	equal percentage, linear, quick open
Shut-off class:	ASME B16.104 V (standard metal seat) ASME B16.104 VI (shut-off soft seat)
Pipe connection type:	flange type, butt welding type
Applicable temperature range:	-30 - 260 (single-seat structure) -196 - 570 (double-seat structure)
Actuator type:	pneumatic diaphragm actuator pneumatic piston actuator Electric actuator

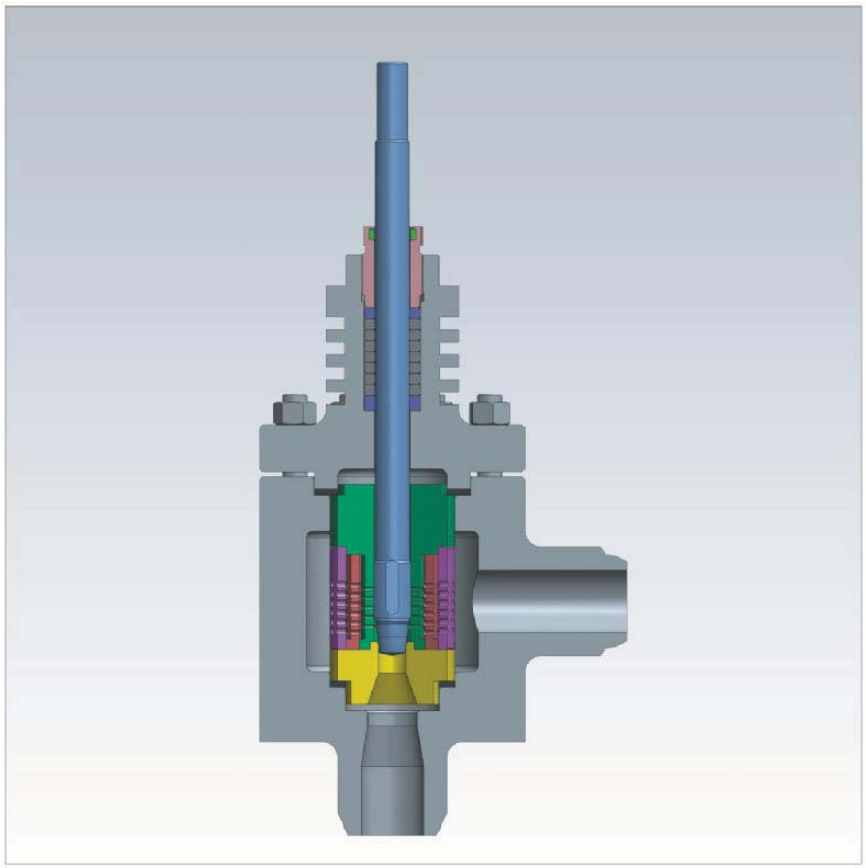
DAGO

▶Exploded view of 10S Series



DAGO

▶10S Series control valve (unbalanced trim)

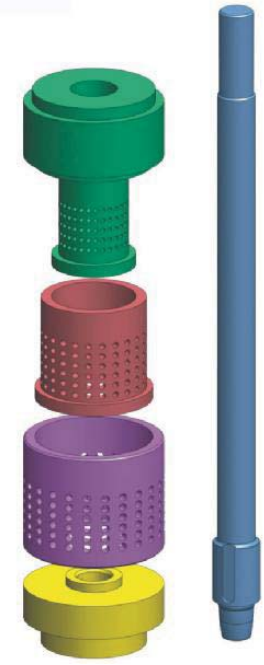


▲ Outline

The 10S Series unbalanced multi-stage pressure drop control valve is suitable for applications with high differential pressure and applications that produce flash evaporation and cavitation. According to the requirements in different service conditions, it is designed with various multi-hole cages that form a multi-stage pressure drop trim, so that the internal energy of high speed media is consumed and flow velocity is reduced from the time when the fluids contact the first cage. As it is composed of various cages, the pressure is gradually reduced so that the medium pressure is always above the saturated vapor pressure, and the occurrence of flash evaporation and cavitation is eliminated. The standard configuration is the unbalanced single-seat plug and the plug and seat are subjected to hardening treatment to prolong the service life of the trim. The valves of large sizes can be designed with the balanced single-seat plug structure.

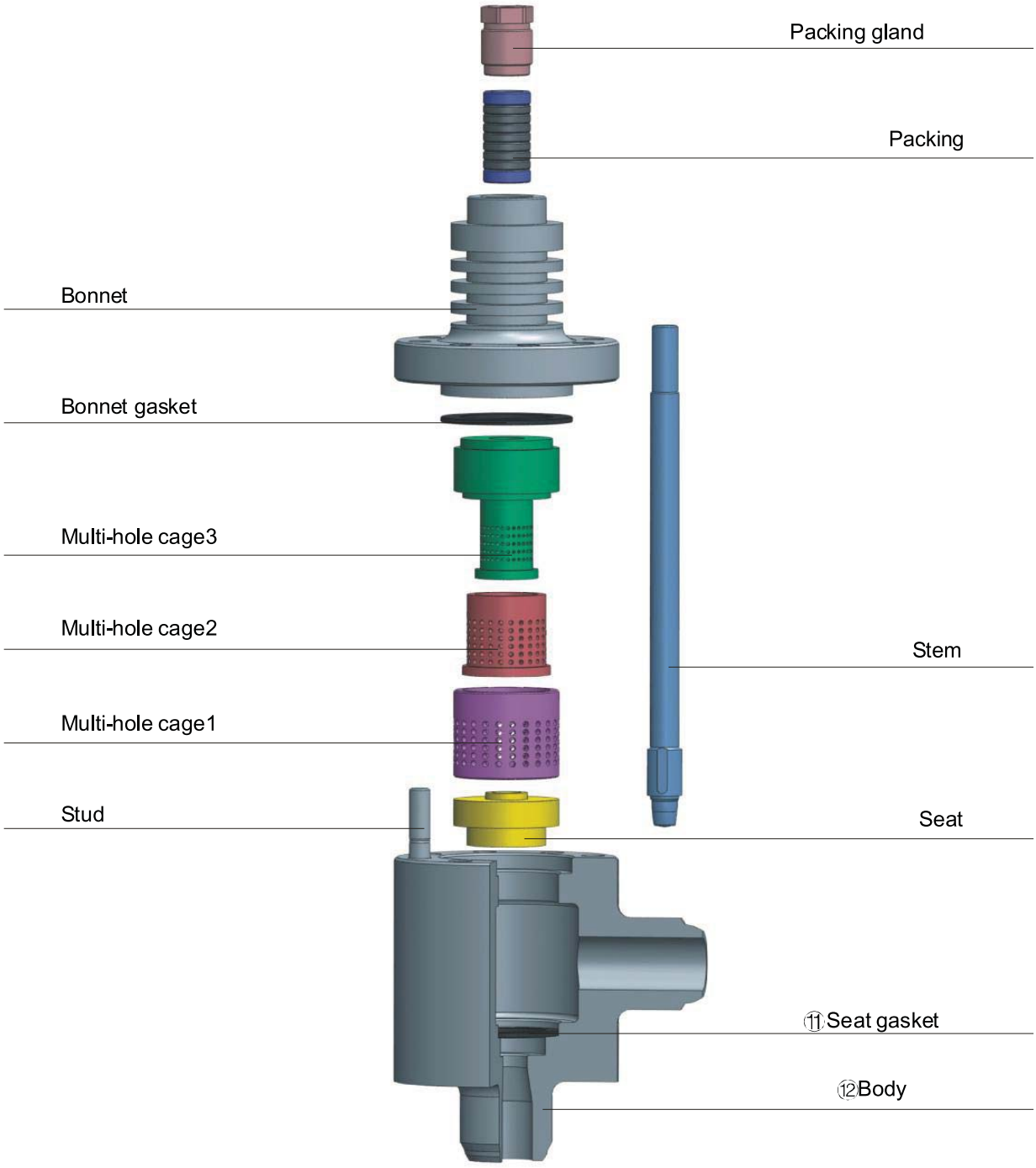
▲ Parameters of control valves:

Trim features:	sleeve guided unbalanced trim structure, combination of multi-hole cages
Body type:	straight-through type, angle type
Bonnet type:	standard type, heat dissipation type, cryogenic type, bellows
Flow characteristic:	equal percentage, linear, quick open
Shut-off class:	ASME B16.104 V (standard metal seat) ASME B16.104 VI (shut-off soft seat)
Pipe connection type:	flange type, butt welding type
Applicable temperature range:	-196 - 570
Actuator type:	pneumatic diaphragm actuator pneumatic piston actuator Electric actuator



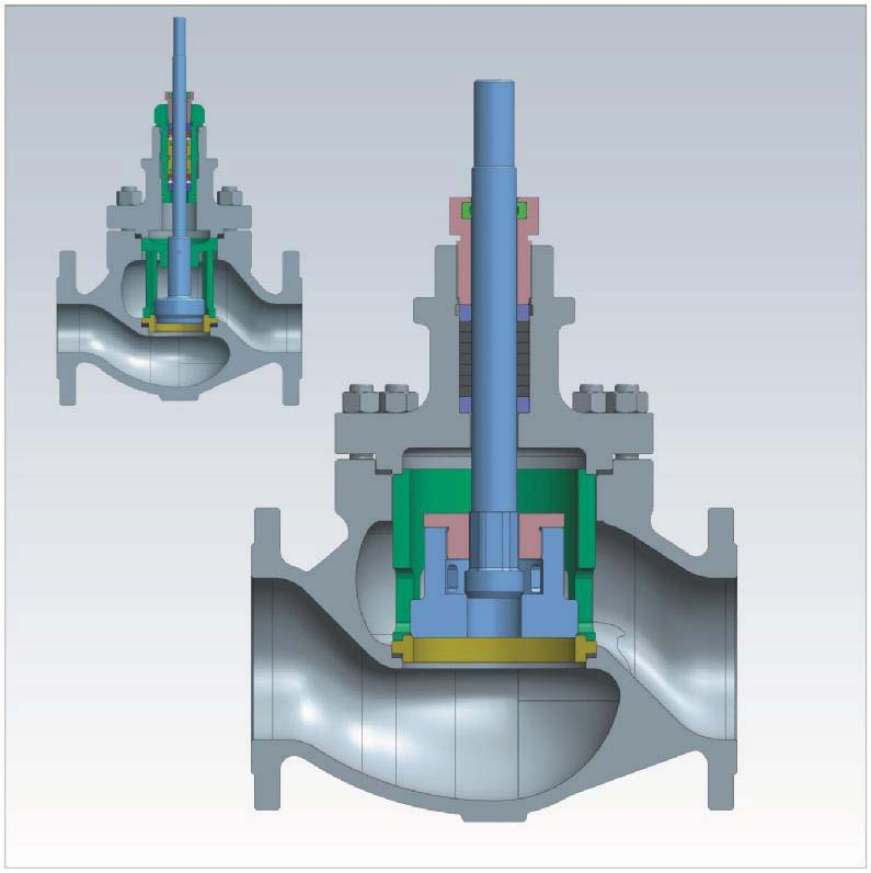
DAGO

▶ Exploded view of 10S Series (unbalanced trim)



DAGO

▶ 10Q Series control valve



▲ Outline

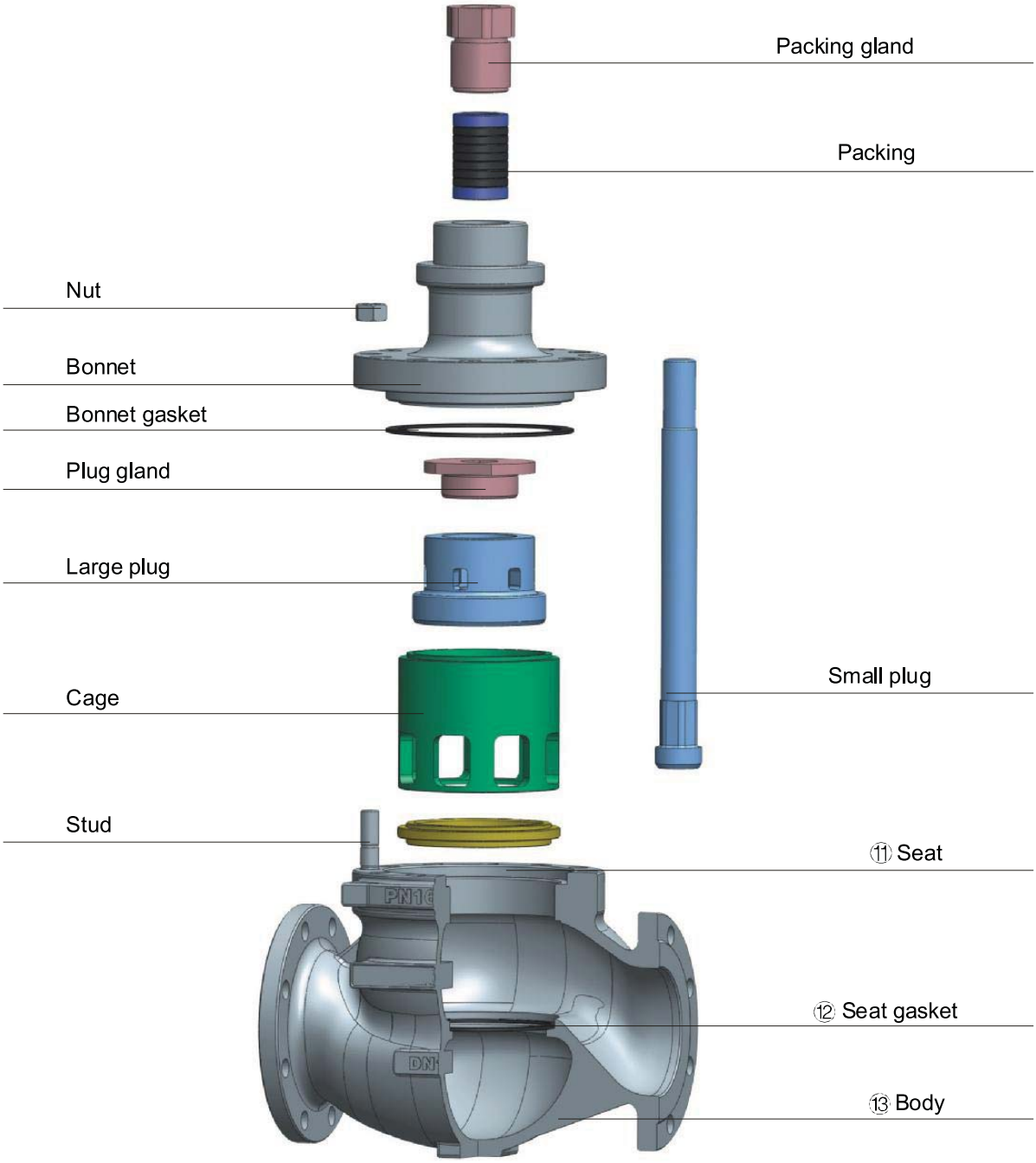
The 10Q Series unbalanced shut-off valve adopts top guided pressure unbalanced plug. It is suitable for applications with low differential pressure. The plug and seat surfaces are subjected to hard alloy overlay welding to ensure long-time stable running of the valve. For shut-off applications of media of high temperature and service conditions with high differential pressure, we have specially designed the double-plug pressure relief type shut-off valve. The trim of this kind of valve adopts double-plug structure with flow to off design. When opening the valve, first open the small plug, and the starting force is relatively low because the area of thrust surface of the small plug is small. After the small plug is opened, the pressure after the valve is released and the differential pressure acting on the large plug is greatly reduced. The large plug can be opened with a relatively low actuator force. The trim of this kind of structure can meet the need for shut-off applications in service conditions with high differential pressure.

▲ Parameters of control valves:

Trim features:	sleeve guided type, balanced trim structure, with balanced seal ring structure
Body type:	straight-through type, angle type 。
Bonnet type:	cryogenic type, bellows
Flow characteristic:	Fast opening characteristic
Shut-off class:	ASME B16.104 VI (standard metal seat)
Pipe connection type:	flange type, butt welding type
Applicable temperature range:	-196 - 570
Actuator type:	pneumatic diaphragm actuator pneumatic piston actuator Electric actuator

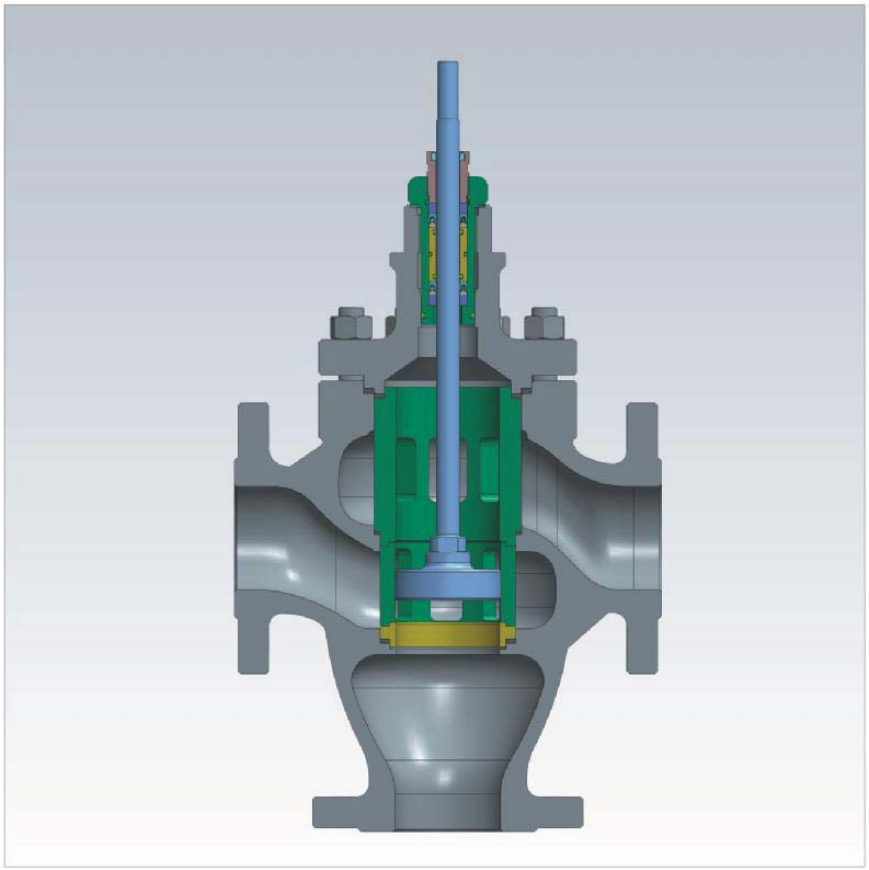
DAGO

Exploded view of 10Q Series



DAGO

▶ 13H/F Series control valve



▲ Outline

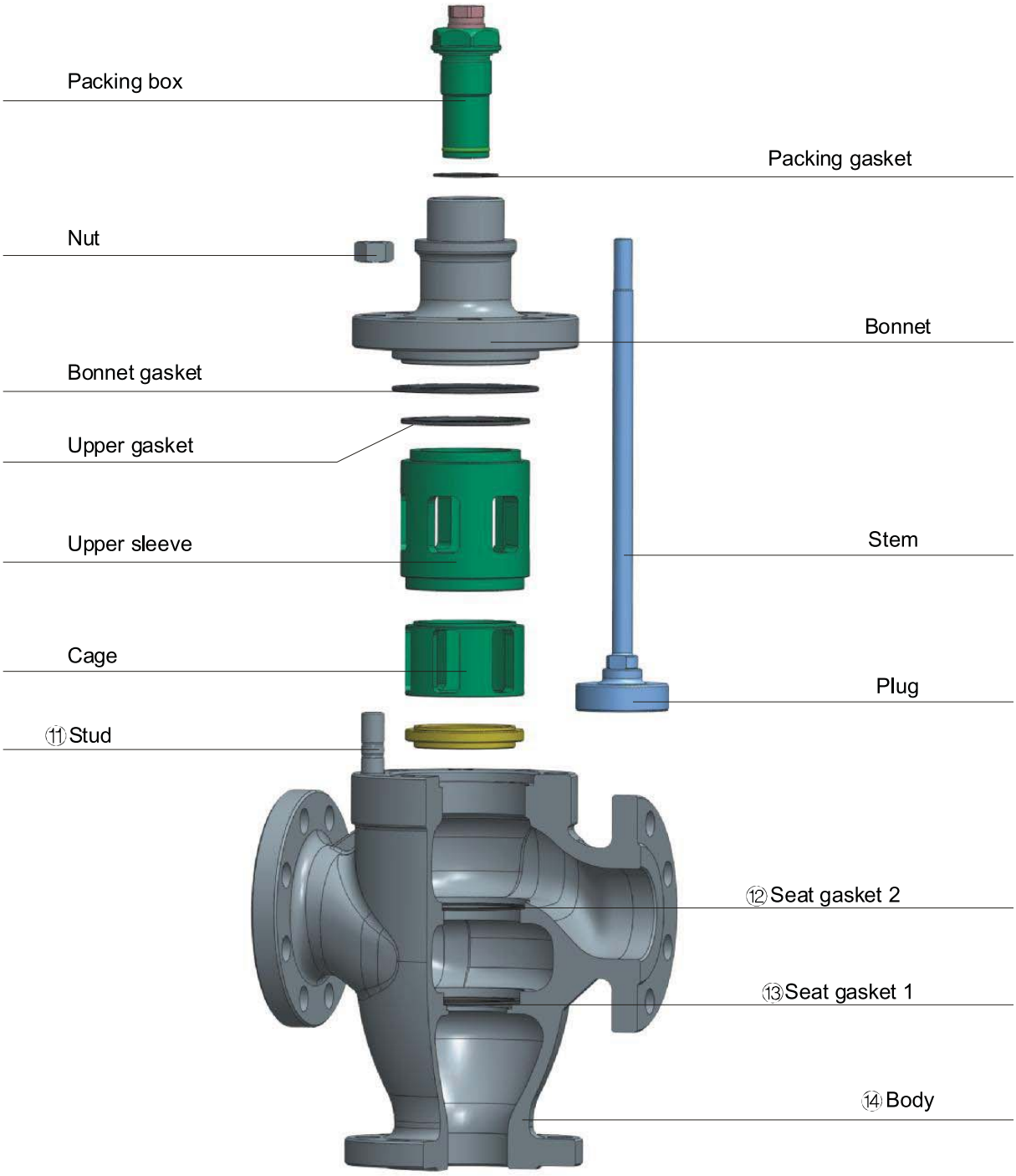
The 13H/F Series three-way converging/diverging control valve adopts the top guided pressure unbalanced plug. It is mainly used for converging or diverging media of several flow channels. Entering from two channels and exiting from one channel is called three-way converging, and conversely, entering from one channel and exiting from two channels is called diverging. The three-way valve can also play the pipe shut-off and opening function. The standard converging/diverging design is the unbalanced double-seat trim structure. In addition, special cages with noise reduction and anti-cavitation functions can also be designed according to the service conditions.

▲ Parameters of control valves:

Trim features:	Double-seat sleeve guided
Body type:	three-way type
Bonnet type:	standard type, heat dissipation type, cryogenic type, bellows
Flow characteristic:	equal percentage, linear, quick open
Shut-off class:	ASME B16.104 IV (standard metal seat)
Pipe connection type:	flange type, butt welding type
Applicable temperature range:	-196 - 560
Actuator type:	pneumatic diaphragm actuator pneumatic piston actuator Electric actuator

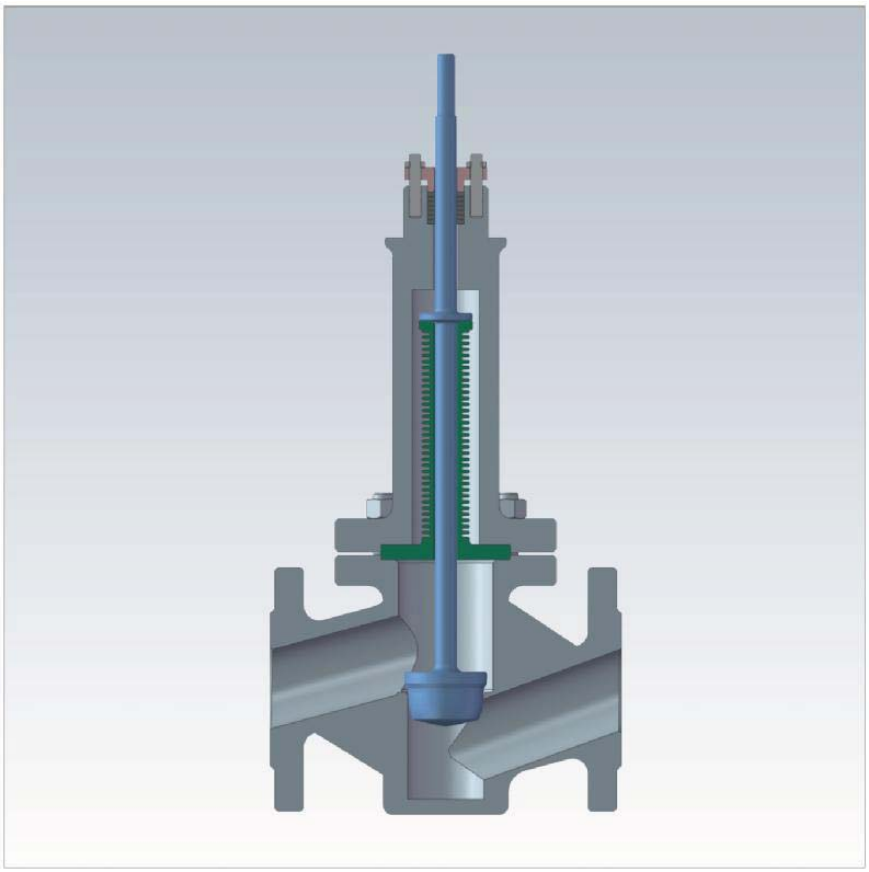
DAGO

Exploded view of 13H/F Series



DAGO

▶ 10PF Series control valve



▲ Outline

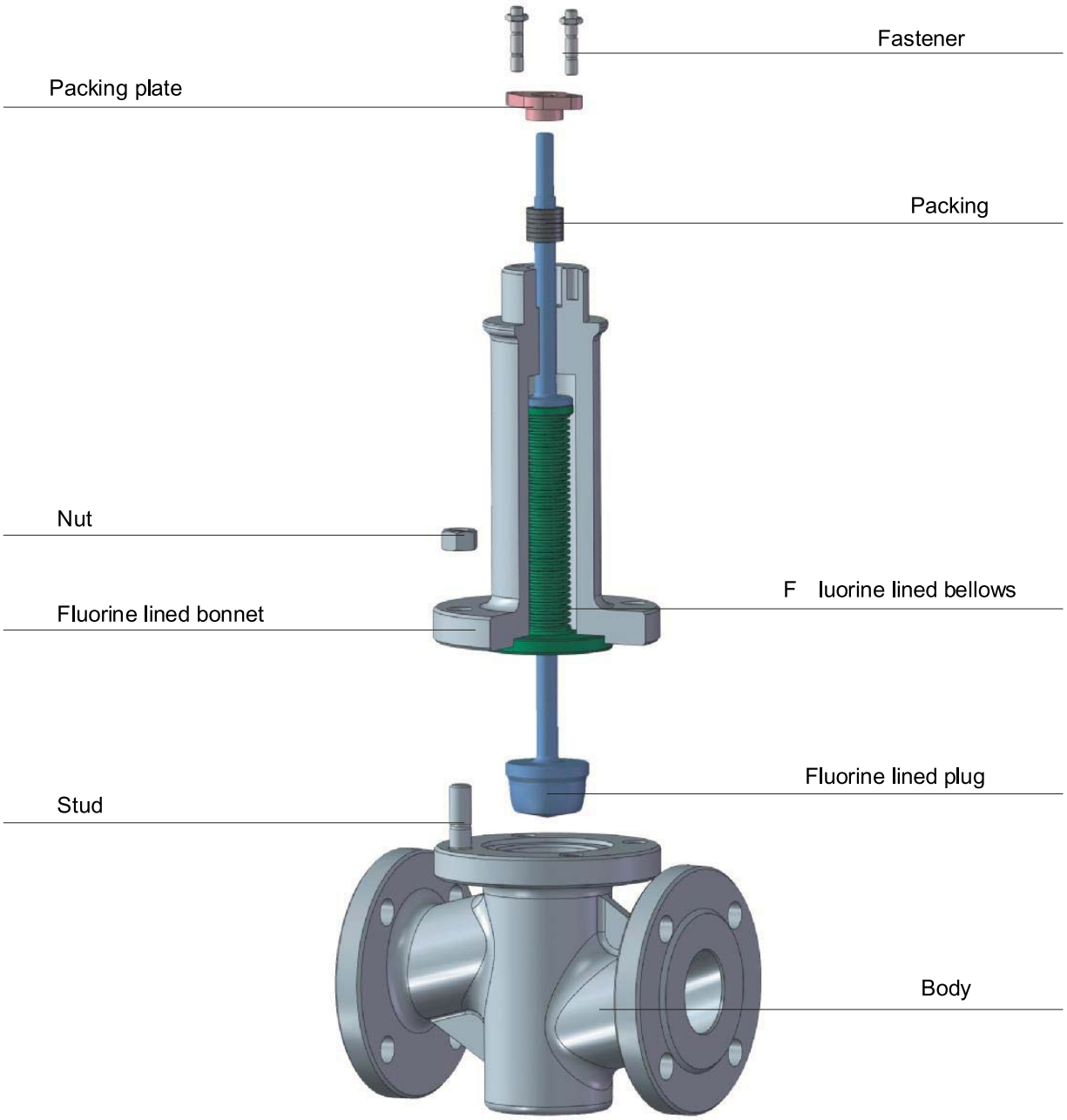
The 10PF Series linear motion single-seat lined control valve adopts full fluorine lined body and trim structure to effectively prevent the corrosion of metal materials in the valve by corrosive media. The metal body cavity is subjected to serrated machining treatment so as to make the lining materials fully fit into the metal and prolong the service life and performance of lining materials. The stem seal is the compound seal of F46 bellows seal and V PTFE packing, which can eliminate the possibility of media leaking from the stem to the outside. The unbalanced full lined control valve is especially suitable for very corrosive media under low pressure and normal temperature service conditions.

▲ Parameters of control valves:

Trim features:	unbalanced plug, lined seat, bellows stem seal
Body type:	straight-through type
Bonnet type:	standard type, bellows type
Flow characteristic:	equal percentage, linear, quick open
Shut-off class:	ASME B16.104 V
Pipe connection type:	flange type
Applicable temperature range:	-45 - 150
Actuator type:	pneumatic diaphragm actuator
	pneumatic piston actuator
	Electric actuator

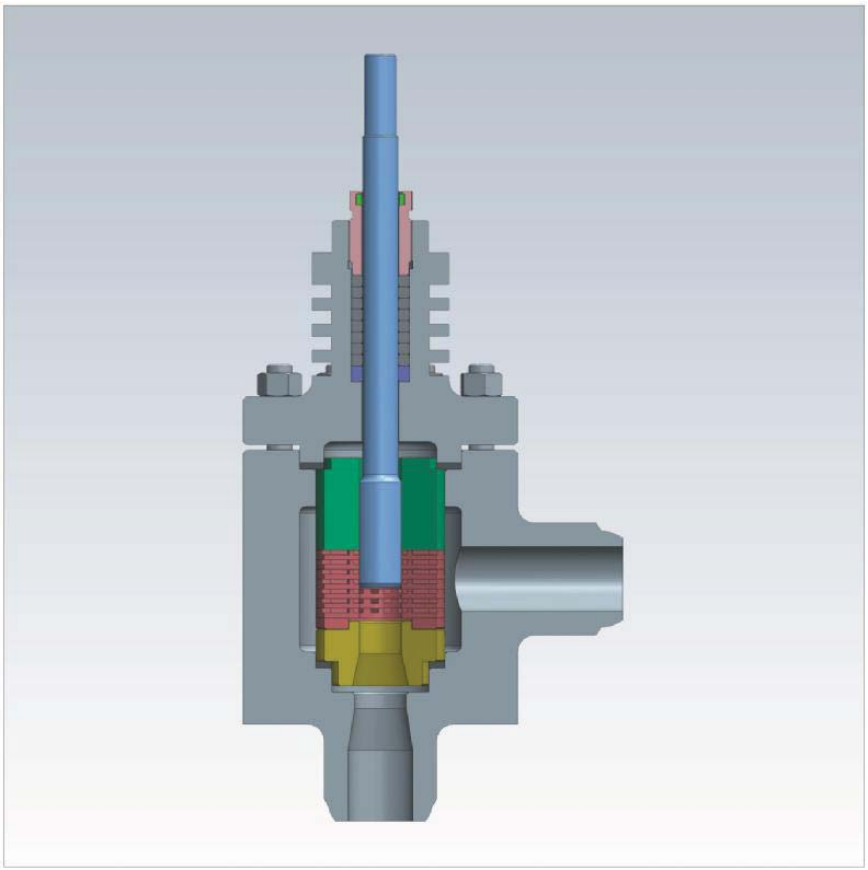
DAGO

Exploded view of 10PF Series



DAGO

10M Series control valve (unbalanced trim)



▲ Outline

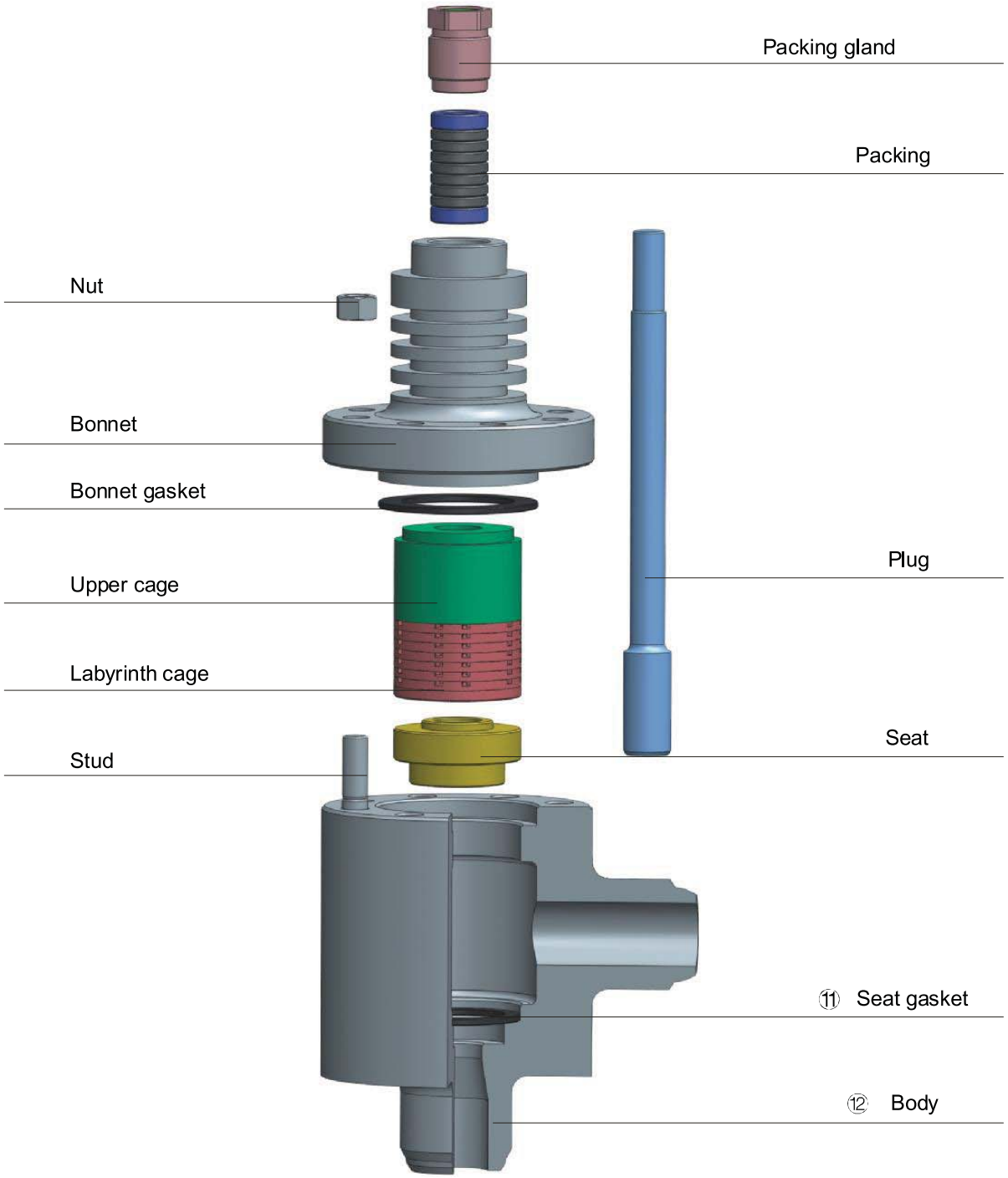
The 10M Series unbalanced labyrinth control valve adopts the labyrinth cage and unbalanced trim design. The labyrinth sleeve is composed of cylindrical discs with many coaxially distributed labyrinths. According to different technological parameters of the media, different labyrinth specifications and piling layers are designed to form the cage and the cage divides the whole flow channel into several tiny circuitous or step flow channels, forcing the fluids to continuously change the flow direction and flowing area and gradually reducing the pressure of fluids, so as to prevent the occurrence of flash evaporation and cavitation and prolong the service life of the trim. The unbalanced single-seat is adopted. The trim is suitable for service conditions under which blocked flow will easily be produced and cavitation will be caused. The unbalanced trim is suitable for applications of small sizes and high temperature.

▲ Parameters of control valves:

Trim features:	sleeve guided unbalanced trim structure, labyrinth disc cage combination
Body type:	straight-through type, angle type,
Bonnet type:	standard type, heat dissipation type, cryogenic type
Flow characteristic:	equal percentage, linear, quick open
Shut-off class:	ASME B16.104 V (standard metal seat) ASME B16.104 VI (shut-off soft seat)
Pipe connection type:	flange type, butt welding type
Applicable temperature range:	-196 - 570
Actuator type:	pneumatic diaphragm actuator pneumatic piston actuator Electric actuator

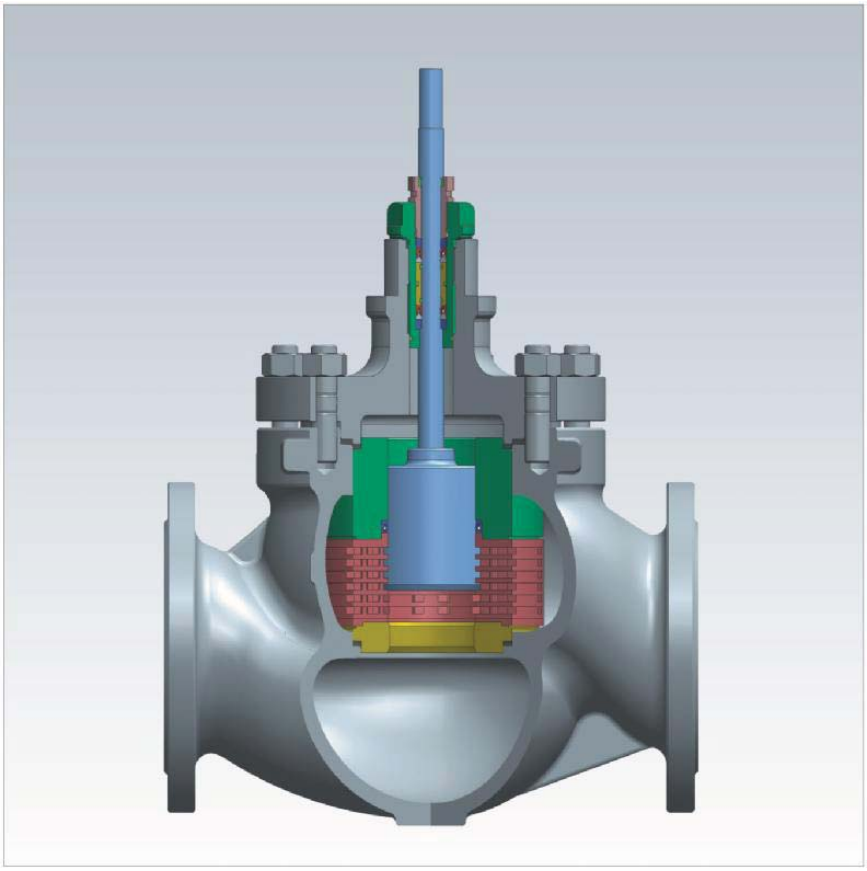
DAGO

Exploded view of 10M Series (unbalanced trim)



DAGO

▶ 10M Series control valve



▲ Outline

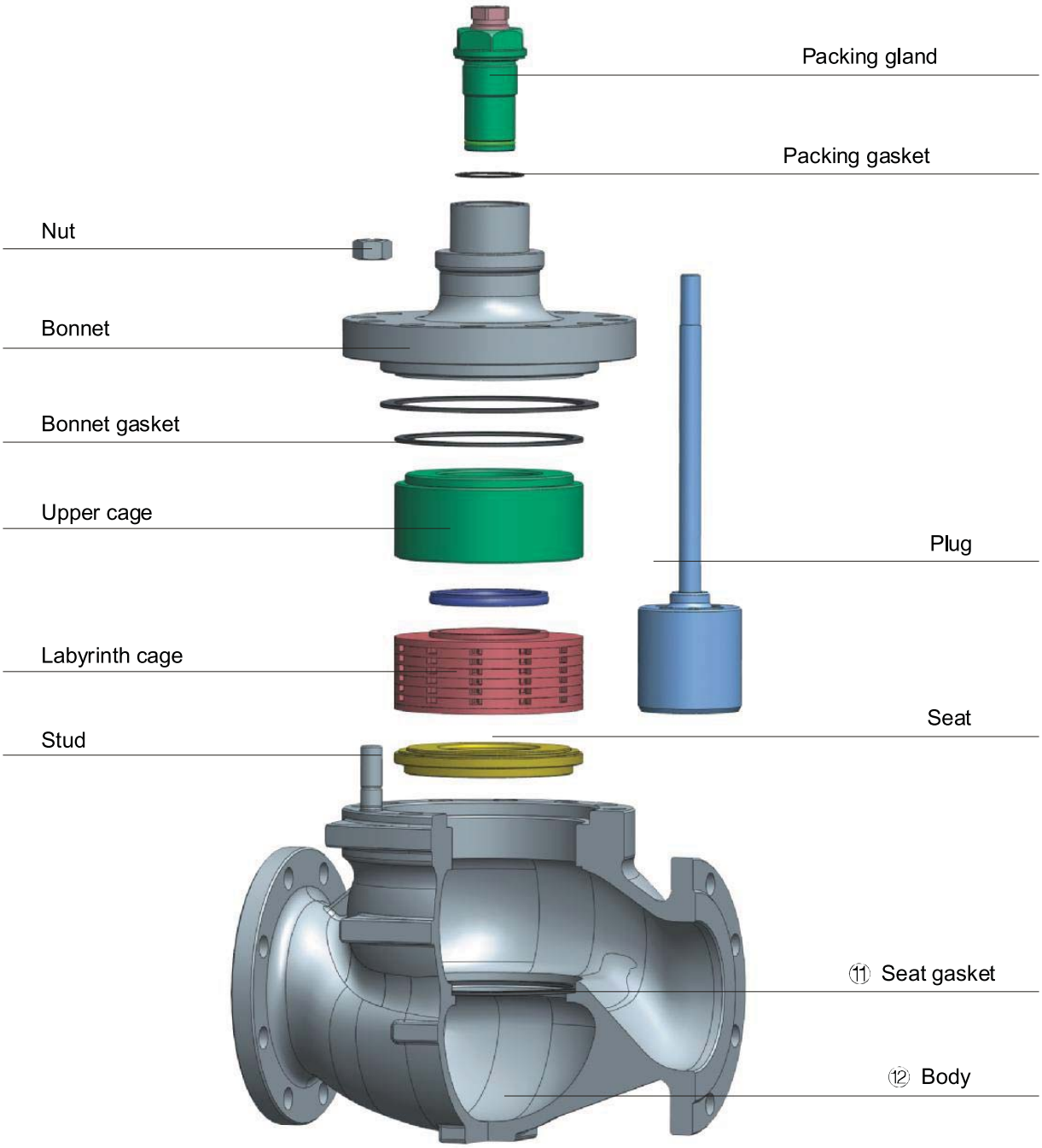
The 10M Series balanced labyrinth control valve adopts the labyrinth cage and balanced plug design. The labyrinth sleeve is composed of cylindrical discs with many coaxially distributed labyrinths. According to different technological parameters of the media, different labyrinth specifications and piling layers are designed to form the cage and the cage divides the whole flow channel into several tiny circuitous or step flow channels, forcing the fluids to continuously change the flow direction and flowing area and gradually reducing the pressure of fluids, so as to prevent the occurrence of flash evaporation and cavitation and prolong the service life of the trim. The balanced sleeve plug is adopted. The closely fit plug and seat ensure very low leakage. The trim is suitable for service conditions under which blocked flow will easily be produced and cavitation will be caused.

▲ Parameters of control valves:

Trim features:	sleeve guided type, balanced trim structure
Body type:	straight-through type, angle type
Bonnet type:	standard type, heat dissipation type, cryogenic type
Flow characteristic:	equal percentage, Linear, quick open
Shut-off class:	ASME B16.104 V (standard metal seat) ASME B16.104 VI (shut-off soft seat)
Pipe connection type:	flange type, Butt welding type
Applicable temperature range:	-30 - 260 (single-seat structure) -196 - 570 (double-seat structure)
Actuator type:	pneumatic diaphragm actuator pneumatic piston actuator Electric actuator

DAGO

Exploded view of 10M Series



▶ Control principle of labyrinth control valve

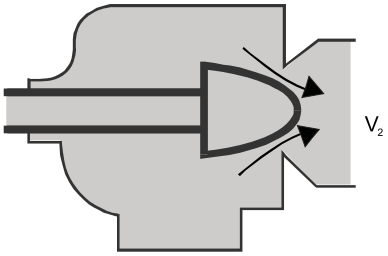


Figure 1: single-stage pressure drop

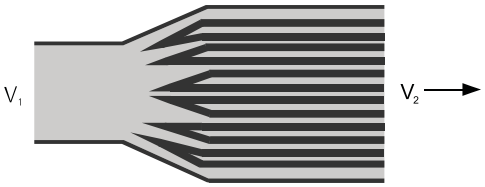


Figure 2: multiple flow channels pressure drop

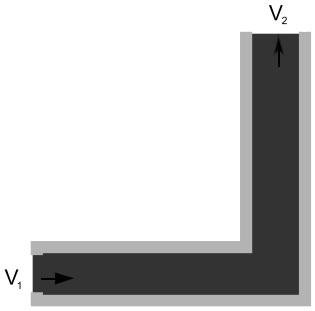


Figure 3: labyrinth flow channel

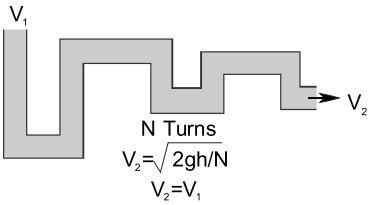


Figure 4: labyrinth multi-stage pressure drop

▲ The labyrinth flow channel can realize control of flow velocity

The labyrinth control valve can prevent the plug from producing high flow velocity and ensure the final control effect: The medium pressure and flow velocity can be effectively controlled during the whole travel of the valve. The labyrinth cage scatters the fluids into several split flow to reduce the flow velocity as much as possible (figure 2). Each fluid channel is composed of specific quantities of right-angled bends that form the labyrinth flow channels (figure 3). During the process, each bend will reduce the flow velocity of the flowing media to a certain extent.
The bend number N is the number that is required for scattering the maximum differential pressure in the plug (figure 4). See the following formulas:

$$V2(Hole)=\sqrt{2gh}$$

A new formula is obtained.

$$V2(10M)^{®}=\sqrt{2gh/N}$$

▲ Speed control principle of labyrinth control valve

The valve that is damaged by cavitation, flash evaporation, vibration and noise produced by the media that passes through the valve at a high flow velocity is the main cause that leads to failure of control in the system.
Even if the valve is not damaged, bad process control caused by too high noise and severe vibration will lower product performance and influence the running capacity of the equipment.
Based on the principle of fluid mechanics, the labyrinth control valve adopts speed control principle and technology and makes use of multi-stage pressure drop to eliminate cavitation, flash evaporation, vibration, noise, etc., providing overall system control solutions for many different application fields.
Under severe service conditions, bad performance of valves is caused by too high flow velocity. The maximum flow velocity of the fluids in the valve always occurs at the throttling face (figure 1) which is at the downstream side of the restriction orifice of the plug. Even if materials of relatively high hardness are used in the valve to control the damage caused by cavitation, only a small amount of faults in the valve caused by too high flow velocity of the media can be eliminated. The flow velocity of media in all valves must be controlled so as to maintain the performance and reliability of the valves.

▶ Cavitation cause and solution

▲ Cause of cavitation

When the fluid pressure is reduced to the saturated vapor pressure or lower, flash evaporation or bubbles will occur. In most control valves (figure 5), the inlet pressure is P1, velocity is V1. When the fluid passes through the plug necking area, the velocity is increased to Vvc. According to the principle of conservation of energy, the fluid pressure suddenly drops to Pvc. When Pvc is equal to or less than the liquid saturated vapor pressure Pv, the liquid will be gasified and bubbles will be produced, so that flash evaporation occurs.
After the fluid passes through the plug, the pressure starts to be restored and the kinetic energy is transferred into potential energy again. When the pressure is restored to the downstream pressure, which is expressed as P2 and the velocity is V2. When the restored pressure exceeds the saturated vapor pressure Pv, the bubbles formed will be broken and cavitation will occur. This kind of energy release will increase the partial stress to be above 200000PSI (1400MPa) and the stress will rapidly destroy the solid plug.

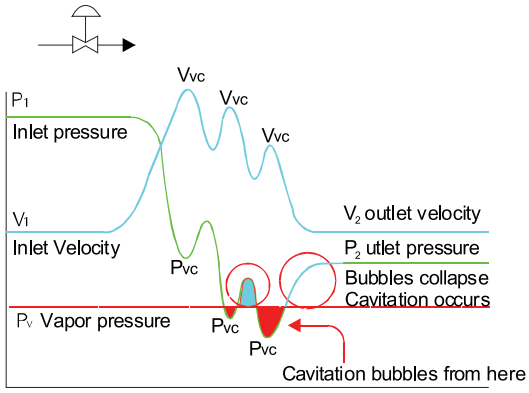


Figure 5: Cause of Cavitation

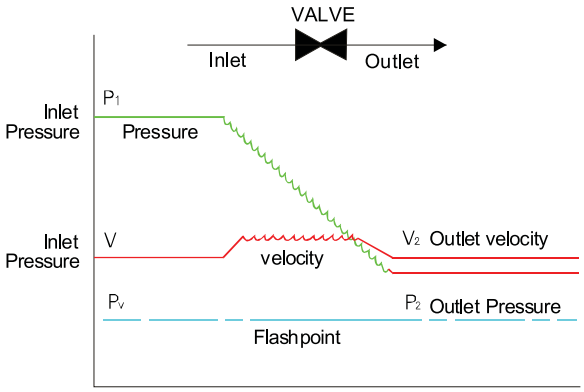


Figure 6: cavitation effectively solved by the labyrinth cage

▲ Solution to cavitation

The labyrinth control valve can effectively eliminate the damage caused by failure of control of fluid velocity.
First, the fluids are scattered into many small flow channels. Thus, even the bubbles are formed, their volume is very small and the energy is not sufficient to produce stress that can damage materials. Secondly, the flow velocity is maintained at the lowest level. Thus, the partial pressure will not be reduced to be lower than the fluid vaporizing pressure. Therefore, cavitation will not occur.
The damage caused by cavitation is a typical signal that indicates failure of control of flow velocity. As is mentioned above, the adoption of materials of high hardness, insulating sleeve or downward orifice will only eliminate a small amount of faults in the valve caused by cavitation. The high flow velocity will cause cavitation and damage the plug, and the solution to cavitation is to adopt the labyrinth cage as shown in figure 6.
According to the fluid evaporation pressure, the flow velocity can be achieved through the following formulas:

$$V=\sqrt{4637(P_2-P_v)/P}$$ Metric or $$V=\sqrt{1000(P_2-P_v)/P}$$ English