TRUNNION BALL VALVE

CONTENT

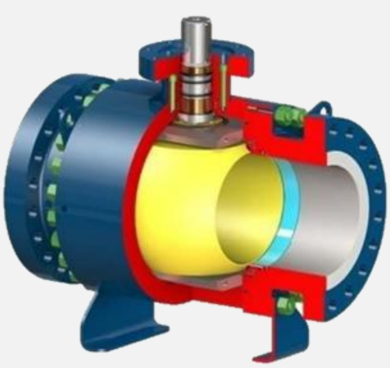
1. Application

Ball valves are designed to fully open or fully close the passage of a fluid in a pipe. They find their main applications in the oil & gas industry, chemical and petrochemical, mining, power engineering, water supply, paper industry, cryogenic applications, etc.
Some design configurations enable the use of these type of valves for short-term throttling, however the throttling in combination with a fluid containing mechanical impurities can result in a loss of tightness.

2. Technical description

The ball valve design meets the requirements of API 6D, PED 97/23/EC or DIN
3230-5 / AD 2000 and EN 14141.
The valve construction is tested in accordance with the relevant normative documents and special regulations for:

- Fire safety (Fire Safe),
- Resistance to wear caused by clean gas, contaminated service and for the transport of solids,
- Low fugitive emissions according to TA Luft / EPA or ISO 15848,
- Seismic resistance,
- Climate resistance,
- Functional safety (SIL), etc.



Split body design

Fully welded body design

2.1 Sizes

Ball valves with trunnion guided ball design can be supplied, depending of the pressure class in sizes from DN 50 (2”) to DN 1400 (56”)

2.2 Design Pressure

Available are valves in pressure classes PN 16 up to PN 420 (ANSI Class 150# up to 2500#)
Operating pressure depends on the materials used and the pressure/temperature curve of each pressure class.

2.3 Working temperature

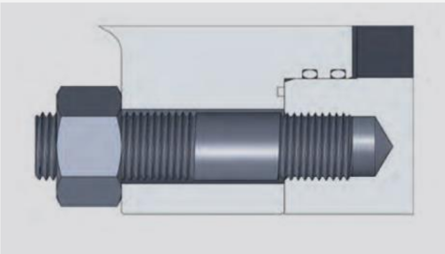
Ambient temperature: -60°C to +80°C
Fluid operating temperature: from -196°C to +450°C (higher temperatures on request).
The operation temperature depends on the materials used and the pressure/temperature curve of each pressure class.

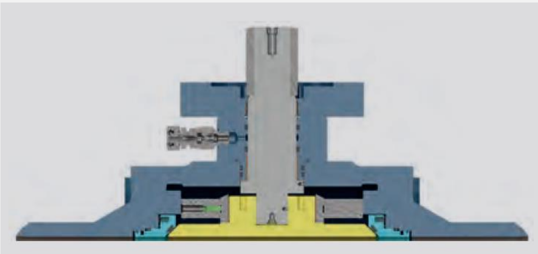
2.4 Body construction

The valve body is made of forged material and consists of two pieces in the sizes DN 50 (2”) up to DN 100 (4”) and of three pieces in the larger sizes. The body parts are connected:

- in a dismantlable way by means of bolted joints to make a “**SPLIT BODY**”. Due to the vertically split and screwed body the valve can be disassembled without special tools. This allows maintenance and repair of the valve’s inner parts.
- in an indivisible way by means of welded joints to make a “**FULLY WELDED BODY**”.

The body construction, in combination with non-destructive tests and examinations of the parts, guarantees constant external tightness of the valve body.


Bolted split body


Fully welded body

2.5 Ball construction and support

The ball is made of a single piece of forged material. In order to make the surface resistant to wear and damage, the surface can be plated with different materials depending on the application, ENP, ENP + Si, Stellite weld deposit, F316 stainless steel, nickel alloy , or hard coatings like TCC (Tungsten carbide coating) or CCC (chrome carbide coating) applied in HVOF (High Velocity Oxygen Fuel) or others.
There are two ways of guiding the ball: TRUNNION PLATE or TRUNNION STEM.

2.6 Seat construction

Fig	Type of seat	Description	Fluid	Operation temperature	Operation pressure	Material of seat insert	Seals
A	Seat PMSS with elastomer or thermoplastic (Fig 3a)	The sealing is obtained by elastomers or thermoplastics inserted into the metallic ring	Gases with low content of mechanical impurities	*from -46°C to 220°C	Class 150# to 900#. (PN16 to PN 160) Class 1500# (PN250) only to 6" (DN 150)	POM, PEEK, HNBR, VITON	HNBR, VITON[R]
B	Seat with thermoplastic (Fig 3b)	The sealing is obtained by elastomers or thermoplastics inserted into the metallic ring	Liquids and gases with low content of mechanical impurities	*from -60°C to 220°C	Class 150# to 2500# (PN16 to PN420)	RPTFE, PEEK	HNBR, VITON[R]
C	Metal to metal seat (Fig 3C)	Sealing surfaces of the seat and the ball are hard coated. The surfaces are lapped together to achieve the required tightness	Contaminated gases and liquids, mixtures of solids and liquids	*from -46°C to +450°C	Class 150# to 2500# (PN16 to PN420)	Metal + TCC (or CCC) applied in HVOF (or other hard coatings)	HNBR, VITON[R]. Graphite (for temperatures above 240°C)
D	Cryogenic seat (Fig 3d)	Tightness is provided by a seat insert made of RPTFE or PCTFE (KEL-F) thermoplastic	Liquified gases	*to -196°C	Class 150# to 1500# (PN16 up to PN160)	RPTFE (up to -100°C) PCTFE (up to -196°C)	Lip seal
	** Special seats	Depending on the fluid and the service parameters, special designs are available	Steam, sea water, chemical compounds, etc.	To request	To request	Various elastomers and thermoplastics (NYLON[R], DEVLON[R], etc.)	Elastomers of other types, graphite, etc.

*Temperature range of the ball valve depends on the material of the seat insert and the material of the seals. Temperature limits of the material used for the body are defined in ANSI B16.34 or EN 1092-1
** The design of special seats is always a part of the documentation submitted with the proposal.

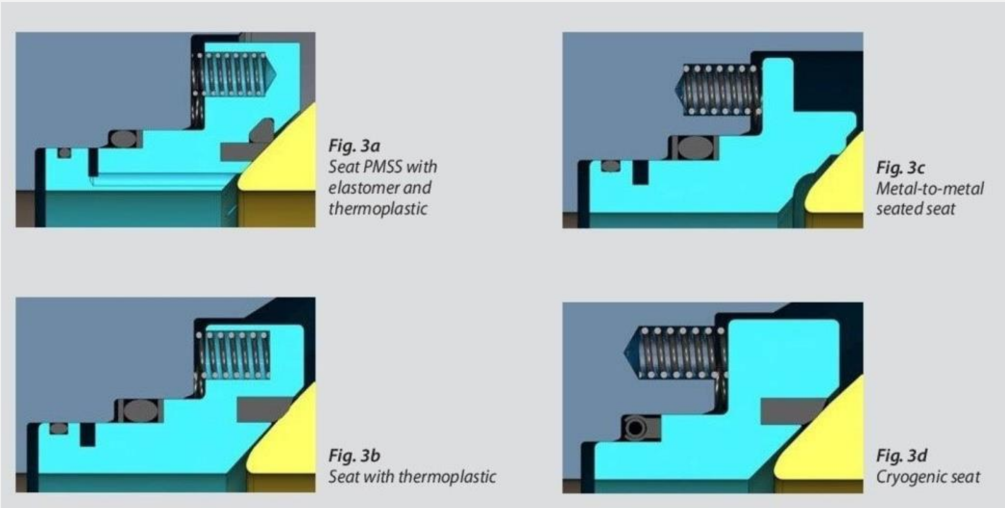


Fig. 3a Seat PMSS with elastomer and thermoplastic

Fig. 3b Seat with thermoplastic

Fig. 3c Metal-to-metal seated seat

Fig. 3d Cryogenic seat

*PMSS – Primary Metal Secondary Soft

All types of seats can have two functional arrangements alternatively:

Single piston effect
The seats are self-relieving, an increased pressure in the body cavity is automatically relieved upstream of the valve.
If not defined otherwise, the valves are supplied with this seat design.

Double piston effect
Both seats are pushed against the ball permanently by the springs and the piston effect from the pressure of the fluid acting on the seat. There is no relieving of overpressure in the cavity, so it is recommended to use venting connections with this seat design.

See detailed description below (Page 8)

2.7 Stem construction

The standard design of the stem support meets the "ANTI BLOW OUT" requirements, this means the stem cannot be ejected from the valve body by pressure of the fluid. The stem is both radially and axially supported so that no load is applied to the sealing rings. The stem is sealed with O-rings, a graphite packing or a combination of several seals that are independent of each other. Ball valves in sizes DN 150 (6") and larger can be equipped, on request, with an emergency sealant injection port.

3. Connection to the pipe

- Flanged ends (RF, RTJ, or other) According to ASME B16.5, ASME B16.47, EN 1092-1, etc.
- Butt welding ends (BW) according to ASME B16.25 or EN 12627.
- Flanged ends with counter flanges, bolting material, and sealing elements
- Butt welding ends with pup pieces
- Combination of one end with flange and the other with weld end

4. Valve bore

- Full bore according to manufacturer´s standard and scrapable according to API6D / ISO 14313
- Reduced bore according to API 6D / ISO 14313 or as required by customer.

4.1 Face to face and end to end dimensions according to:

As standard the valves are supplied according to the following normative of dimensions

- API 6D / ISO 14313
- ASME B16.10
- EN 558-1 (flanged ends)
- EN 12982 (but-welding ends)

Nonstandard configurations agreed between manufacturer and user

4.2 Flow characteristic for full bore valves

DN	40	50	80	100	150	200	250	300
NPS	1 ½”	2”	3”	4”	6”	8”	10”	12”
Kv m^3/h	150	250	760	1300	3300	6500	10700	16700
Cv US gallons per min	170	290	870	1500	3800	7470	12300	19200
ζ factor	0,18	0,16	0,11	0,09	0,07	0,06	0,05	0,05

DN	350	400	450	500	550	600	650	700
NPS	14”	16”	18”	20”	22”	24”	26”	28”
Kv m^3/h	23500	31600	41100	51800	64000	77400	93200	109500
Cv US gallons per min	27000	36300	47300	59600	73600	89000	107200	126000
ζ factor	0,04	0,04	0,04	0,04	0,04	0,03	0,03	0,03

DN	750	800	850	900	1000	1050	1200	1400
NPS	30”	32”	34”	36”	40”	42”	48”	56”
Kv m^3/h	127000	144000	162000	181000	250000	279000	371000	536000
Cv US gallons per min	146000	165600	186300	208100	287500	320900	426700	616400
ζ factor	0,03	0,03	0,03	0,03	0,03	0,02	0,02	0,02

Kv: is the full capacity flow rate through the ball valve in m^3/h with a pressure drop of 1 bar
Cv: is the full capacity flow rate through the ball valve in gallons/min with a pressure drop of 1 psi
ζ factor is the pressure loss coefficient (according to EN 1267)

In general, for the cv or KV values of fully open, full bore ball valves the values used for pipes can be applied. The main characteristic of a ball valve is that there is no restriction in the pass.

5. Materials

The selection of materials of individual components depends on the service conditions (fluid, pressure, temperature).
For pressure containing parts within the meaning of API6D, material certificates according to ISO 10204 3.1 are used as a standard, or inspection certificates according to ISO 10204 3.2 upon request.

5.1 Standard materials

Component	Carbon steel		
	For temp. range -46°C till +300°C	**For temp. range -60°C till +300°C**	**For temp. range -25°C till +300°C**
Body	A350 LF2	*A350 LF2	A350 LF2
Bonnet			
Ball (basic material)	A182 F316		
Stem	17-4PH		
Seat (basic material)	A182 F316		
Seat inserts	POM	PEEK	PEEK
Seat and ball surface at metal seated design	TCC applied in HVOF		
Bolts	A320 L7		
Nuts	A194 Gr 4		
Seals	HNBR	HNBR	VITON^R

*Material tested for -60°C (impact test)
The temperature range for materials subject to pressure / temperature curve and applicable technical standards
Temperature range can be limited depending on the seal material used

5.2 Other materials

Component	Other possible materials (extract)
Body	A105, A182 F316, A182 F51, A182 F55, 17-4PH, nickel alloys, titanium
Bonnet	A105, A182 F316, A182 F51, A182 F55, 17-4PH, nickel alloys, titanium
Ball (basic material)	A105 with ENP coating, A350 LF2 with ENP coating, A182 F6a, 17-4PH, A182 F51, A182 F51, nickel alloys, titanium
Stem	A182 F6a, A182 F51, A182 F55, nickel alloys, titanium
Seat (basic material)	A182 F304, A182 F51, A182 F55, nickel alloys, titanium
Seat inserts	NYLON[R], DEVLON[R]
Seat and ball surface at metal seated design	Stellite, CCC applied in HVOF
Bolts	A193 B7, A193 B7M, A193 B8, A320 L7M
Nuts	A194 2H, A194 2HM, A194 7, A194 7M, A194 Gr.8, A194 8M
Seals	KALREZ[R], LIPSEAL[R]

Other materials on request

6. Operation

Ball valves can be actuated with following types of actuators.

- Manual (lever)
- Manual with gear operator
- Electric actuator
- Pneumatic actuator
- Hydraulic actuator
- Gas over oil actuator
- Others

All actuators can be supplied with the corresponding automation components.
For more details see the description of the different types of actuators.

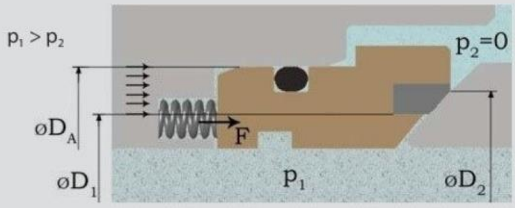
7. Design features

7.1 Body cavity pressure relief

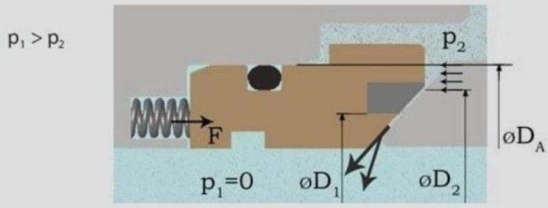
This feature is used for fluids that are expanding when exposed to increased temperature.
The pressure relief can be done in several ways:

- Seats with single piston effect design
- One seat with single piston effect design (upstream) and one seat with double piston effect design (downstream)
- Use of pressure relief device

7.1.1 Single piston effect (standard feature)

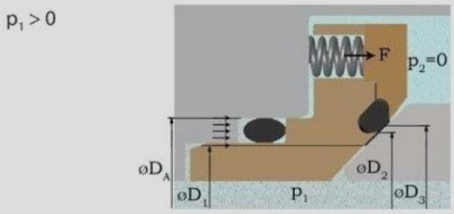


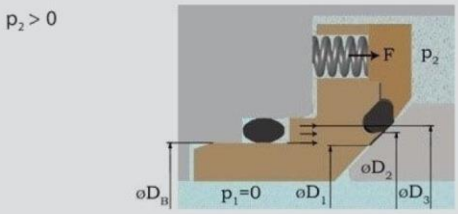
The seat is pushed against the ball permanently by the spring force (F) and by the piston effect - from the overpressure of the fluid in the valve bore acting on the annulus defined by ø D_A and ø D_1.



When the pressure of the fluid in the body cavity exceeds the pressure of the fluid in the valve bore, it means $p_2 > p_1$, the seat is pushed away from the ball

7.1.2 Double piston effect (on request)

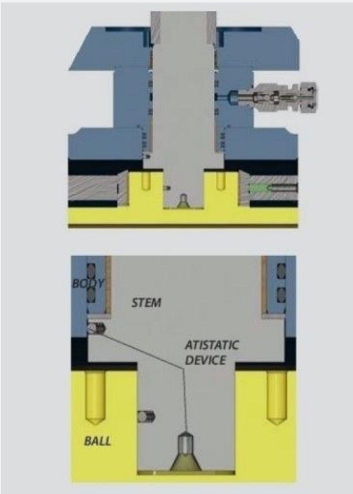




The seats with DOUBLE PISTON EFFECT are not self-relieving

7.2 Antistatic design (standard feature)

The design provides for electrical continuity between the ball, stem and body.



7.3 Upper stem seal removable from the outside (standard feature)

The upper section of the stem packing can be removed and replaced with a dismantling of the valve. This work can be done on the installed valve.

7.4 Fire safety (on request)

Fire safety has been proofed according to the following standards: API607, API6FA, ISO 10497, BS 6755.

7.5 Seismic and vibration resistance (standard feature)

Resistance has been proven by special tests according to GOST 30546

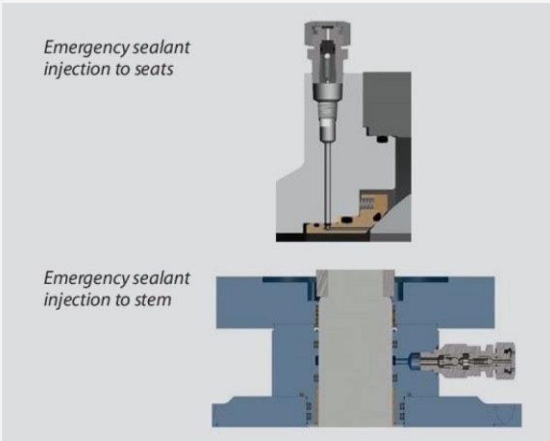
7.6 Service safety (standard feature)

The valves are certified to SIL 3 according to EN 61508

7.7 Possible additional accessories (on request)

- Draining port
- Venting port
- Sealant injection at the seats for sizes DN 100 (4”) and larger
- Sealant injection at the stem for sizes DN 150 (6”) and larger
- Stem extension
- Set for underground installation
- Relief devices
- Pups

Stem extension for underground installation



Emergency sealant injection

8. Test

The valves are subjected to the following tests according to API, ASME, EN or other standard:

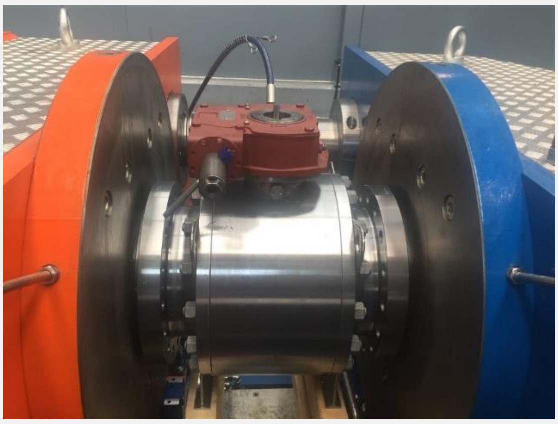
- Pressure tests
- Functional tests
- Non-destructive tests and examinations

The scope of testing is specified by the requirements of the customer.

- Material traceability certifications according to EN 10204 3.1 or 3.2

8.1 Standard tests if not specified otherwise

- Hydrostatic pressure test according to API 598 at 1.5 times the nominal pressure of the valve, done with water
- Seat tightness test according to ANSI/FCI70-2 Class IV at 1.1 times the nominal pressure of the valve, usually done with water.
- Seat tightness test according to ANSI/FCI70-2 Class IV at low pressure (4 bar g), usually done with air.
- Functional test with an actuator without pressure



8.2 Additional tests on request

Material tests

- X-ray of welding seams
- Dye impregnation
- Magnetic particles distribution
- PMI (Positive Material Identification)

Valve tests

- Functional test under pressure
- Low pressure test with gas (0,34 / 1 bar) (API6D H3.2)
- Low pressure test with gas (5.5 / 6.9 bar) (API6D H3.3)
- High pressure body test with gas (API6D H4.2)
- High pressure seat test with gas (API6D H4.3)

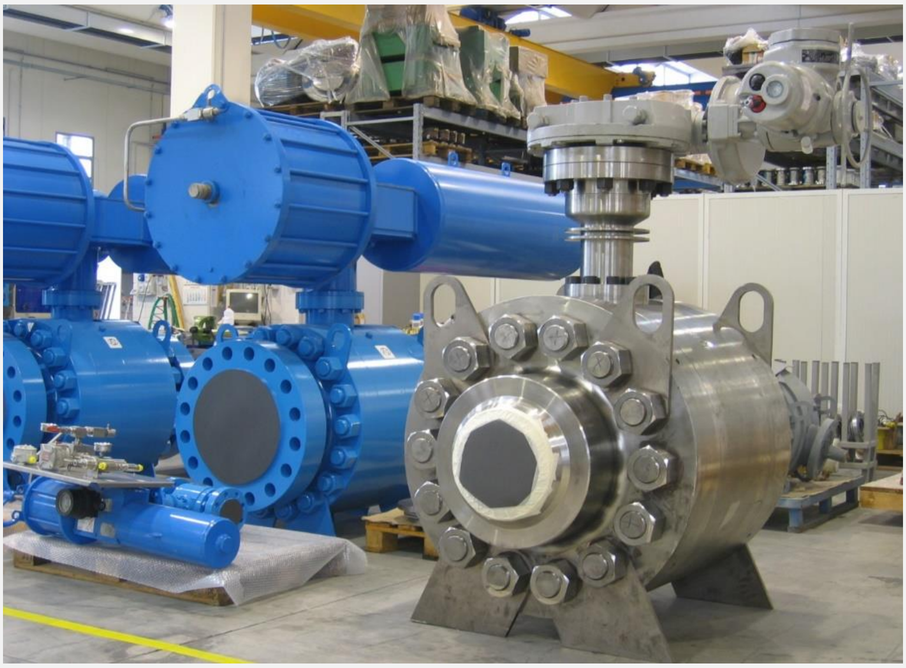
- Antistatic test (API6D H5)
- Torque measurement (API6D H6)
- Cavity relief test (API6D H8)
- Double block & bleed test (API6D H9)
- Double isolation & bleed DIB-1 (API6D H10)
- Double isolation & bleed DIB-2 (API6D H11)

9. Installation

Ball valves can be installed into any piping (horizontal, vertical, inclined), but taking account the instructions applicable to the installation of the actuator.
Ball valves with diameters ⩾ DN 150 (6”) are equipped with foundation plates and lifting eyes as a standard.

10. Advantages of EXaL ball valves

- Many variants of design configurations
- Full and smooth bore resulting in very low-pressure loss and options for scraper services.
- Long term reliability and maintenance free service
- Possibility to use different type of actuators with couplings according to ISO 5211



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