RANGER

VALVE AMERICA

API 6D SLAB AND EXPANDING GATE VALVES

ASME CLASS 150 - 2500#

CONTENTS

RANGER
VALVE AMERICA

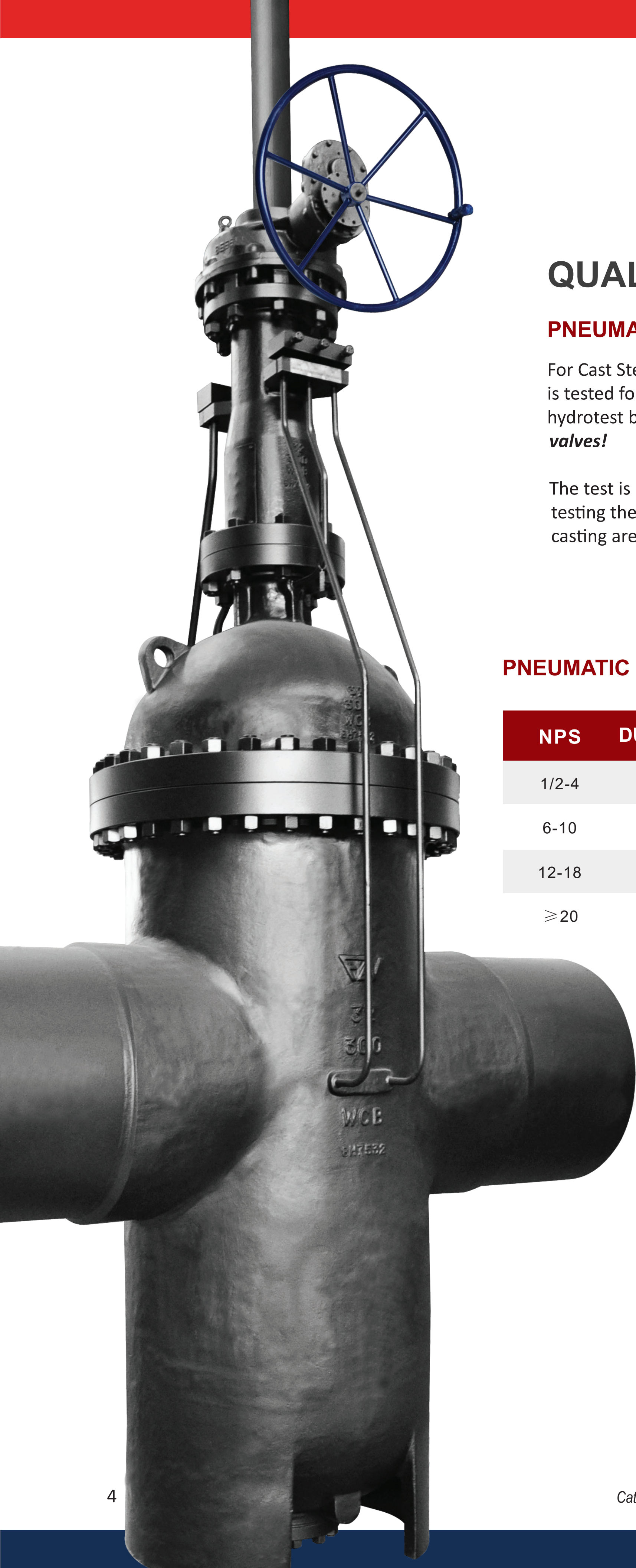
Ranger Valve America Ltd. (Ranger) is a specialized supplier of API 6D, API 600, API 609, API 602, API 608, API 594, API 623, as well as API 6A and API 16C valves and flow control components, including industrial valves and wellhead equipment.

Ranger works closely with its partners and strives to exceed expectations.

Ranger works to provide a rigorous research and development program aimed at product design, innovation and validation. Ranger™ uses a full spectrum of inspection and test equipment to ensure that all products meet or exceed the quality standards, including:

- Mechanical: tensile, impact and hardness testing;
- NDE: PT, MT, UT
- Chemical: PMI
- Fugitive emission
- Shell™ type acceptance test(TAT).

As well, Ranger simulates various tests in critical and crucial working conditions to verify product performance.



QUALITY CONTROL

PNEUMATIC SHELL TEST

For Cast Steel Gate, Globe and Check Valves, the body casting integrity is tested for small leaks which are difficult to detect during the required hydrotest by performing a ***High Pressure Pneumatic Shell test on all valves!***

The test is performed by submerging the valves in water and pressure testing the valves with compressed air or nitrogen. Any pinholes in the casting are easily spotted as gas bubbles in the water.

PNEUMATIC SHELL TEST DETAILS

NPS	DURATION (MIN.)
1/2-4	4
6-10	10
12-18	20
⩾20	30

CLASS	TEST PRESSURE (Psi)
150	300
300	575
600	725
900	725
1500	2175
2500	3625

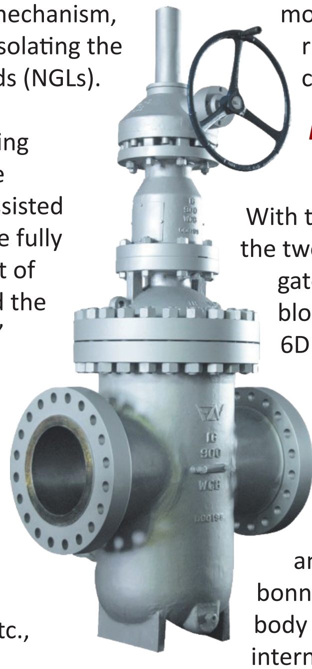
THROUGH CONDUIT SLAB GATE VALVE

INTRODUCTION

The ***RANGER Through Conduit Slab Gate Valve*** has been designed for minimal pressure loss across the valve and to use the line pressure to energize the sealing mechanism, therefore, making this type of valve ideal for isolating the flow of crude/refined oil and natural gas liquids (NGLs).

The principle construction of this valve is a rising stem, one-piece, floating slab gate with a bore sized hole through it and two, line pressure assisted floating seat rings. When the slab gate is in the fully open position, the combination and alignment of the slab gate hole, with the two seat rings and the valve bore, create a perfect "through conduit" flow for the medium with minimal turbulence and for the easy access of pigs, scrappers and hot tap cutters.

Perfect "through conduit" flow



Also in this open position, as the seat sealing faces are not in direct contact with the abrasive/erosive action of the medium or the debris generated by the pigs, scrappers, etc., the seats are not damaged and therefore the service life of the seats are extended. Having seat rings that function and seal similar to the single piston effect seats of a trunnion mounted ball valve; and a similar sealing, line pressure assisted floating closing member of a floating ball valve, the slab gate valve utilizes the full line pressure acting upon the floating slab gate and the upstream seat ring to move laterally so as to seal on the downstream seat ring as if the medium flow has been shut-off and closed by a blind flange.

Fully bi-directional, zero leakage seal with block, isolation and bleed capabilities as per API 6D

With the slab gate in the fully close position and the two seat rings sealing on both sides of the slab gate, a fully bi-directional, zero leakage seal with block, isolation and bleed capabilities as per API 6D is produced, with also double block and bleed capabilities in the fully open/close positions.

With the correct combination of body and trim materials, with soft or metal seats, the sealing design enables the slab gate valve to operate under severe service, high and low pressure and temperature operating conditions. The bolted bonnet design provides for top entry into the valve body for the inspection, repair and replacement of all internal components, after depressurizing the system, without having to remove the valve from the line. The seating torque is approximately 25% less than an API 600 wedge gate valve of a similar size and pressure rating.

THROUGH CONDUIT SLAB GATE VALVE
KEY FEATURES

- Full bore for pigging
- Bi-directional, zero leak sealing at high/low pressures
- Block, isolation and bleed capabilities as per API 6D
- Internal cavity pressure relief
- Stem/Seat sealant injection
- Low operating torque
- Hard/Soft faced seat rings
- Anti blowout stem
- Back seat stem sealing
- Position indicator rod
- Operator mounting flange as per ISO 5210
- Top entry for in-line maintenance
- Pressure range: Class 150 to 2500
- Pressure testing standard: API 6D
- Leakage rates: API 6D/ISO 5208 (Rate A soft seat; Rate D metal seat)
- Fire test: API 6FA
- Fugitive emission: API 624, MESC 77/312 - EPA 21
- Size range: 2" to 48" / DN50 to DN1200
- Temperature range:
  - -29°C to 190°C (-20°F to 374°F)
  - -46°C to 210°C (-50°F to 410°F)
  - higher temperature range available on request

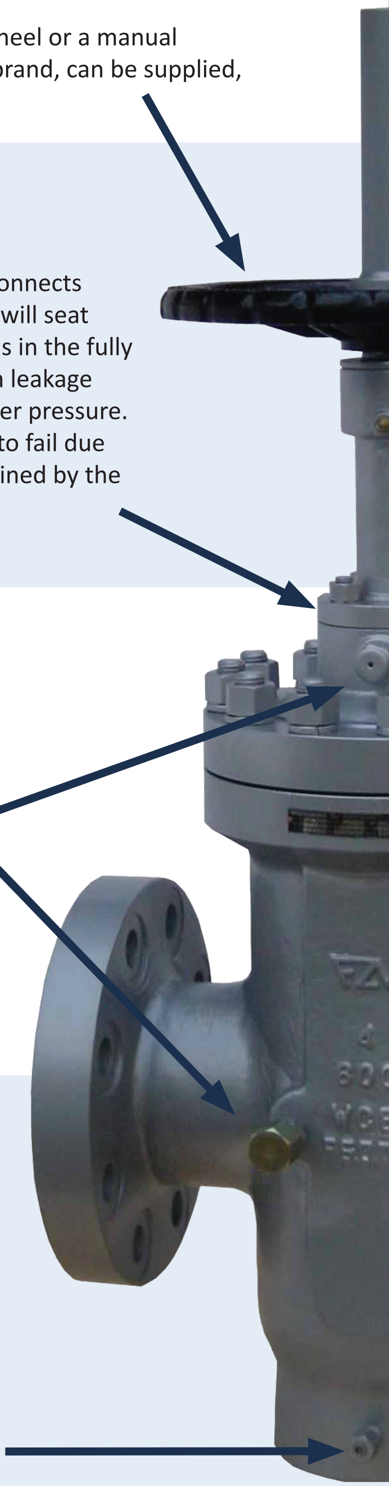
Key Features

VALVE OPERATORS

Depending upon the operating torque of the valve, the standard operating method is to use a hand wheel or a manual gearbox. Power assisted electric, hydraulic or pneumatic actuators, as per the customers' choice and brand, can be supplied, fitted and set-up at the workshop.

ANTI-BLOWOUT STEM

Anti-Blowout/Back Seat Feature: The one-piece forged stem is designed with a "T" at the end which connects with the slab gate "T". A tapered shoulder above the "T" connection is machined into the stem which will seat against the bonnet back-seat bushing, so as to form a zero leak, mechanical tight seal when the valve is in the fully open position. This will enable repair/replacement of the stem packing/stem nut without any medium leakage around the stem packing area. It is not recommended to conduct these repairs with the valve still under pressure. Therefore, with the valve under pressure and if the "T" connection on the stem or the slab gate were to fail due to excessive open/close operating forces, or the stem nut was being removed, the stem would be retained by the stem/back-seat bushing feature from being ejected by the internal pressure.



STEM/SEAT SEALANT INJECTION

Sealant injectors are fitted into the seat/stem area on the outer surfaces of the valve so that a sealant can be injected through into these areas if any leakages are detected. Leakages at the seat/stem areas are mainly due to the failure/damage of seat seals/O-rings/packing from a prolonged service life and/or debris in the medium. The service life of the valve can be extended until the next service schedule by the injection of the correct sealant. Leakage through the stem packing is shown by the evidence of the medium around the stem-to-gland/gland flange area or through the drilled hole in the stem stuffing box if a lantern ring has been fitted. Leakage through the seat ring seals is shown by the evidence of the medium passing through the open vent plug when the body cavity pressure is relieved.

OPTIONAL FEATURES

The following optional features/services are available:

- Valves for cryogenic service.
- Top entry design for in-line maintenance.
- Extended stem for buried service.
- Climate controlled cleaning, assembly and testing for the supply of oxygen and cryogenic valves.
- Chain wheel operated gearbox for manual operation of valves that are not easily assessable.

DRAIN PLUG

As this type of valve is primarily used where there are solid particles in the medium, a drain plug is positioned at the bottom of the valve in the body cavity area, so that the accumulated solids can be drained. The solid particles cannot enter the body cavity when the slab gate is in the open/close position, but only when the slab gate is travelling between the open/close positions.

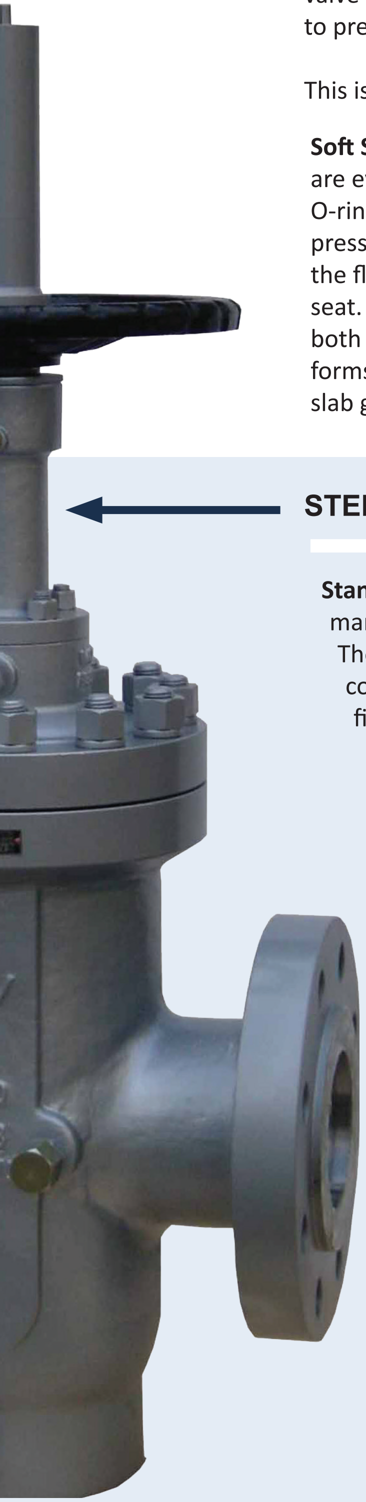
FIRE SAFE DESIGN

The seats and the seat pockets have been designed to be fire safe, so that during a fire where the valve is in the fully closed position, the seats will form a metal-to-metal seal against the slab gate to prevent any leakage from the upstream to the downstream side of the valve.

This is explained as follows:

Soft Seat: During a fire, the soft seals and O-rings are eventually destroyed. As the soft seals and O-rings are being slowly burnt away, the upstream pressure continues to force the upstream seat and the floating slab gate towards the downstream seat. When the soft seals have been fully burnt on both seat rings, the metal face of the seat rings now forms a metal-to-metal seal on both sides of the slab gate face.

Metal Seat: Without soft seals, both of the metal seat seals are always in full contact on both sides of the slab gate face during a fire, which provides a full-time seal during the start to finish period of the fire. For metal seated seat rings with the rubber compound insert, the seat ring will act as a normal metal seat ring because the insert has already been pressed into its retaining groove under normal operating conditions.



STEM SEALING

Standard Packing: The packing consists of five graphite rings, with the top and bottom rings being manufactured from braided graphite and the three middle rings being made from die-formed graphite. The top and bottom rings act as the primary and wiping seals, with the middle rings providing the exact control of the fugitive emissions. The stuffing box bore and the stem sealing surfaces are polished to a finish of, or better than 3.2um/125uin and 0.80um/32uin respectively.

The five graphite rings are subjected to a compressive load of 5500psi/380bar via the gland and gland flange, by the tightening of the gland flange nuts. The gland and gland flange have spherical mating surfaces so that any uneven tightening of the gland flange nuts will still impart an equal load to the packing via the gland. Fugitive emissions to MESC 77/312 are achieved.

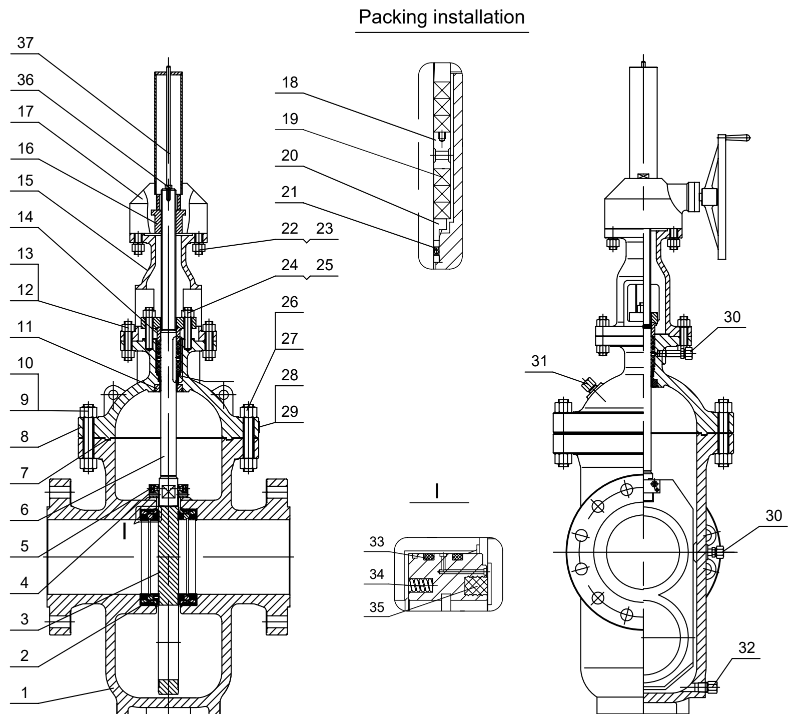
Packing Options:

Packing to EPA 21: Packing suitable to meet the fugitive requirements of EPA 21 can be installed. The packing has passed API 622: Type testing of process valve packing for fugitive emissions. The valve has passed API 624: Type testing of rising stem valves equipped with graphite packing for fugitive emissions.

Sealed Gland: The standard packing set-up is used but the gland is fitted with internal/ external O-rings. These O-rings seal the stem and the stuffing box to the gland, thereby reducing the fugitive emission levels even further. Fugitive emissions to MESC 77/312 and TA-Luft are easily achieved. Applicable between 30 degrees C to +180 degrees C / -22 degrees F to +356 degrees F, due to the limitations of the O-ring material. This type of gland is not allowed to be used with EPA 21 certification.

Lantern Ring: A lantern ring can be fitted using the standard graphite type packing, above and below the lantern ring. A lantern ring is used in conjunction with a leak-off connection to the outside of the stuffing box, to monitor any leakage from the bottom set of packing rings. A pressure gauge and/ or a seal injector can be fitted to aid the monitoring/sealing of the leakage.
Note: This type of gland is not allowed to be used with EPA 21 certification.

Live Loading: A stack of Belleville spring washers are fitted under the gland flange nuts, to provide a calculated, constant compression force to the packing. This will allow the valve to be cycled 5000+ times before any adjustments or repacking is required. Live loading can be fitted to any packing set-up required.



Key components

Item	Part Name	Material
		Sour Service
		ASTM
1	BODY	A216 WCB
2	SEAT	A105N+ENP
3	GATE	A105N+ENP
4	TRAVEL STOP	316SS
5	SCREW	A193 B7M
6	STEM	A182 F6a+ENP
7	GASKET	316+FLEXIBLE GRAPHITE
8	BONNET	A216 WCB
9	NUT	A194 2HM
10	STUD	A193 B7M
11	BACK SEAT	A182 F6a
12	NUT	A194 2HM
13	STUD	A193 B7M
14	GLAND RING	316SS
15	YOKE	A216 WCB
16	STEM NUT	A439 D-2C
17	GEAR BOX	A216 WCB+CS
18	LANTERN RING	316SS
19	PACKING	GRAPHITE+PTFE
20	COMPRESSION RING	316SS
21	SEALING RING	ASSEMBLY
22, 24 & 26	NUT	A194 2HM
23, 25 & 27	STUD	A193 B7M
28	NAME PLATE	316SS
29	RIVET	SS
30	SEALANT INJECTION FITTING	316SS
31	VENT VALVE	316SS
32	DRAIN VALVE	316SS
33	O-RING	AS PER SERVICE REQUIREMENTS
34	SPRING	INCONEL X-750
35	SEAT RING	AS PER SERVICE REQUIREMENTS
39	NUT	A194 2HM
40	INDICATOR ROD	AISI 1035

Note: The main valve components shall be designed and selected as per working conditions of customer requirements. Low-temp. materials available as required.

VALVE DESIGN FEATURES

SEAT RING

Soft Seat

- Soft seated seat rings are used where the line medium does not contain abrasives and a zero leakage rate to API 6D/ISO 5208 Rate A is required. The sealing face of the metal seat ring is ground flat and smooth so that this face can form a metal-to-metal seal against the slab gate face. A soft seal material is inserted into the seat ring sealing face and is usually manufactured from RPTFE or Nylon, depending upon the operating temperature, pressure and line medium.
- The soft seat material will form the initial seal against the slab gate when the valve is pressurized and the slab gate is in the open/close position. The line pressure forces the seat ring against the slab gate face, which presses the soft seat into its retaining groove, while still maintaining a zero leak seal against the slab gate face. At this stage, the metal seat ring sealing face forms a metal-to-metal seal against the slab gate face so that a reliable metal seal and an efficient soft seal is formed and maintained.
- Any debris in the line medium that has collected in the soft seat sealing face area in the close position; is easily removed by the wiping action of the soft seat ring sealing face during the opening stroke.
- During the slab gate travel when the pressures in the body cavity and the line are equal, the soft seat ring will protrude out of its retaining groove and will prevent any metal-to-metal contact between the slab gate and the metal seat ring sealing face.
- In the event of a fire, the metal-to-metal seal will provide the required protection to prevent any leakage from the upstream to the downstream side of the valve. See Fire Safe Design. Carbon steel seat rings are ENP coated to prevent corrosion and galling.

Metal Seat

- The metal seat ring sealing face is usually hard-face, weld deposited with stellite or HVOF sprayed with tungsten/chromium carbide, depending upon the operating temperature and the type of abrasives in the severe service line medium. The metal seat ring sealing face is ground flat and smooth so that this face can form a metal-to-metal seal against the slab gate face during normal operating conditions and in the event of a fire.
- A leakage rate to API 6D/ISO 5208 Rate D is the standard for metal seats, however an API 6D/ISO 5208 Rate A leakage rate can be achieved with careful lapping of the seat ring to the slab gate sealing face which will ensure that a perfect flat, smooth match is created.
- For severe service but not operating at a temperature above 150 degrees C, a rubber compound material can be inserted into the hard face which will help to initialize the seal and also act as a wiper to remove any debris from the slab gate sealing faces during the slab gate travel. During operation, the rubber compound is pressed into its retaining groove when it is in contact with the slab gate face. The addition of this rubber compound seal will provide a zero leakage rate to API 6D/ISO 5208 Rate A. Carbon steel seat rings are ENP coated to prevent corrosion and galling.

Design standards

Design Reference		API
Design Standard		API 6D ASME B16.34
Face-to-face Dimension	Flanged Ends	API 6D ASME B16.10
	Welded Ends	
Adapting Flange		ASME B16.34 MSS SP44
Butt Weld Ends		ASME B16.25
Testing and Inspection		API 6D ISO 5208

Note: The flange connection dimension can be designed and manufactured as per customer requirements.

Product performance specification

Pressure Rating Range		ASME Class*			
		150	300	600	900
Test Pressure at Normal Temperature 38 °C (MPa)	Shell Test	3.0	7.5	15.0	22.5
	Left Sealing	2.2	5.5	11.0	17.5
	Right Sealing	2.2	5.5	11.0	17.5
	Low Pressure Air Seat	≤0.6	≤0.6	≤0.6	≤0.6
Applicable Temperature		-46~210°C or according to customer requirements			
Applicable Service	Standard Service	Oil, Gas, Water and other non-corrosive services			
	Sour Service	Oil, Gas, Water with H_2S, CO_2 and other corrosive services			

* Higher pressure classes available on request.

VALVE DESIGN FEATURES

Seat Sealing

Single Piston Effect (SPE)

The single piston effect seat is designed so that the upstream/downstream line pressure acts upon a "single" area of the seat, causing the seats to move due to this "piston effect" and seal the valve bore on both sides of the slab gate in either the fully open/close positions. The seats are free to float by a few millimeters in an upstream/downstream direction. The seats are sealed to the body by O-rings and to the slab gate by the soft/metal seat seals. Under normal operating conditions, the pressures in the pipe line and in the body cavity are equal. The seats are forced against the slab gate by the line pressure acting upon the rear side of each seat. This is possible because the surface area on the rear of the seat is greater than the surface area on the front side of the seat; therefore, the force is greater. As the downstream line pressure is less than the upstream line pressure, the upstream line pressure will push the upstream seat and the floating slab gate against the downstream seat until the downstream seat contacts the back of the seat pocket. As the downstream seat cannot move any further, a fully bi-directional, zero leakage seal between each seat on both sides of the slab gate is created by the upstream line pressure.

Body Cavity Relief

The SPE also provides a pressure relief system to ensure that the body cavity pressure does not exceed the line pressure, due to fluid thermal expansion. The excess body cavity pressure forces either the upstream/downstream seat away from the slab gate face so that the excess pressure is released into the line.

High DP: With the valve in the close position, with the line pressure blocked from the upstream and the downstream sides. The upstream line pressure is blocked by the line pressure forcing the upstream seat ring against the slab gate and the downstream side is blocked by the upstream line pressure forcing the slab gate against the downstream seat ring. Bleeding/venting are through the body cavity fittings.

Low DP: With the valve in the close position, with the line pressure blocked from the upstream and the downstream sides. The upstream and downstream sides are blocked by the line pressure forcing the two seat rings against the slab gate. Bleeding/venting are through the body cavity fittings.

Seat Sealing

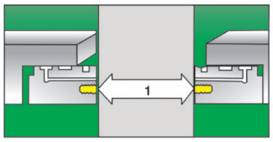


Figure 1

1. When the valve internal pressure is even, the wedge will be in the closed position. The PTFE sealing o-ring on the seat surface acts as the primary sealing. It enables the seat ring to clean both sides of the wedge every time the valve opens or closes (Figure 1).

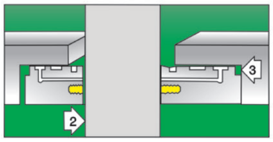


Figure 2

2. When the valve experiences pipeline pressure, the wedge is forced into contact with the PTFE o-ring on the outlet seat, compressing the wedge until it is on the steel seat. This creates double sealing - first PTFE-to-metal sealing and then metal-to-metal sealing. The seat is pressed tightly against the groove. At this point (figure 2, item 3), the o-ring prevents any back fluid from entering.

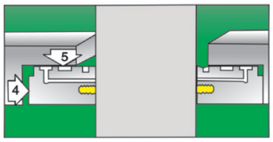


Figure 3

3. Body pressure relief creates inlet sealing. Pipeline pressure on the inlet seat (figure 3, item 4) pushes it againt the wedge, creating double sealing. This creates tightness with the o-ring (figure 3, item 5) and seat groove.

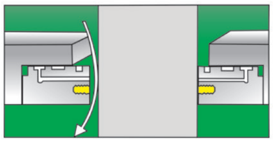


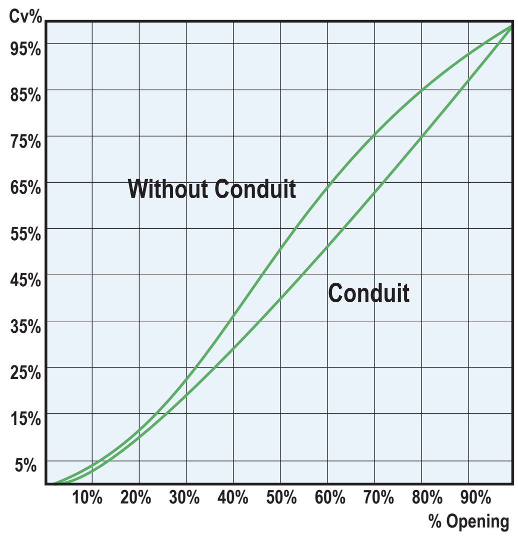
Figure 4

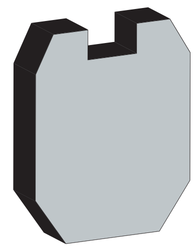
4. When body pressure exceeds pipeline pressure, the inlet seat moves to the groove due to thermal expansion. The extra pressure in the valve is released automatically into the pipeline through the seat and wedge (figure 4).

Flow Characteristics

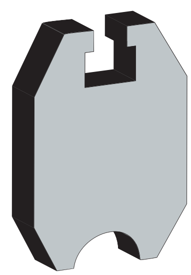
The flow characteristics of the conduit slab gate valve and pipe are equal (equal percentage) if the specifications are the same. The slab gate valve without conduit is a regular cylinder and has less body cavity span than thewedge type gate valve. The remaining characteristics are similar except for less pressure loss compared to the conduit valve. The flow rate regulating characteristics of the modultating type slab gate valve without conduit is better than that of the regular type slab gate valve without conduit.

Valve opening CV curve table

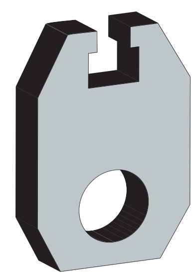




Regular gate

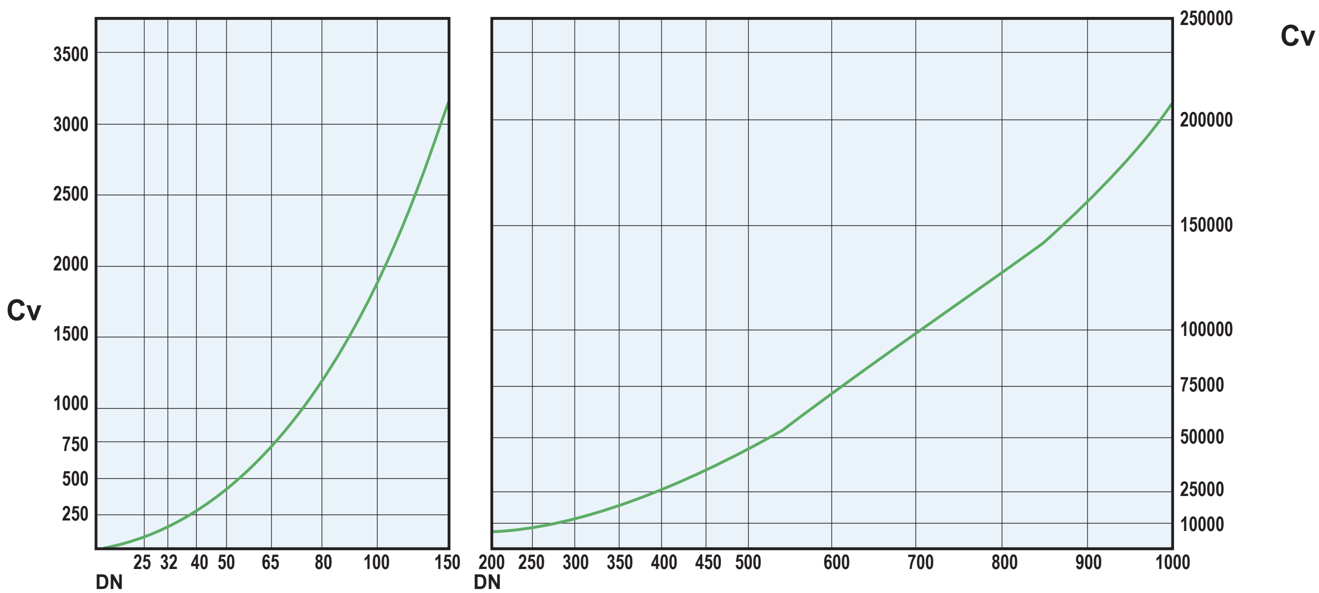


Modulating gate



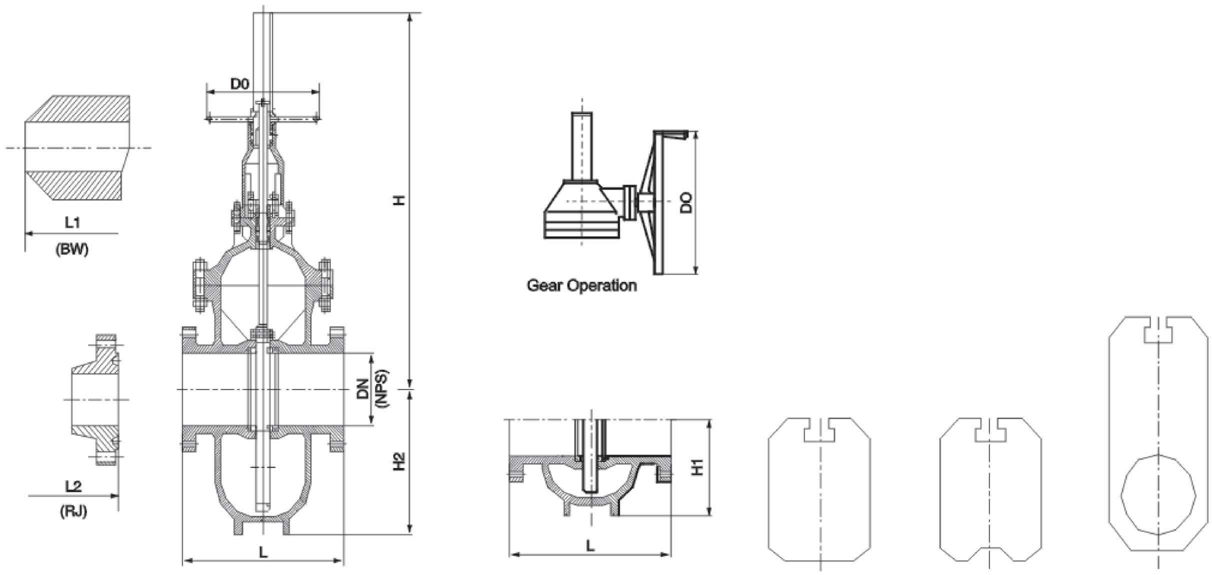
Conduit gate

DN-CV curve of conduit slab gate valve



RANGER

Slab Gate Valve Dimensions



Single Parallel Conduit Gate | Single Parallel Gate w/o Conduit | Regular Type Gate | Modulating Type Gate | Conduit Gate

Main outline dimension (Class 150)

NPS (in)	Flanged Ends	Butt Weld Ends	RTJ Ends	Outline Dimension		Conduit	No Conduit
	L	L1	L2	H	D0	H2	H1
2	178	216	191	495	250	122	85
2 1/2	190	241	204	550	300	154	91
3	203	283	216	610	300	169	109
4	229	305	241	700	350	193	121
6	267	403	279	940	350	283	178
8	292	419	305	1130	425	352	211
10	330	457	343	1290	460	440	215
12	356	502	367	1520	530	514	245
14	381	572	394	1660	610	602	280
16	406	610	419	1850	610	678	310
18	432	660	445	2080	610	785	346
20	457	711	470	2300	650	855	363
24	508	813	521	2680	650	1045	442
26	559	864	-	2880	650	1100	473
28	610	914	-	3080	650	1190	505
30	610	914	-	3250	650	1240	535
32	660	965	-	3491	700	1350	560

* Larger sizes available on request.

Catalog information is current at time of publication, subject to change without notice.

Main outline dimension (Class 300)

NPS (in)	Flanged Ends	Butt Weld Ends	RTJ Ends	Outline Dimension		Conduit	No Conduit
	L	L1	L2	H	D0	H2	H1
2	216	216	232	458	250	137	100
2 1/2	241	241	257	555	300	169	106
3	283	293	298	615	300	184	124
4	305	305	321	710	300	218	146
6	403	403	419	950	350	311	206
8	419	419	435	1135	350	382	241
10	457	457	473	1401	400	476	251
12	502	502	518	1580	460	545	281
14	762	762	778	1625	460	645	325
16	838	838	854	1975	610	728	360
18	914	914	930	2100	610	800	400
20	991	991	1010	2350	650	930	430
24	1143	1143	1165	2810	650	1100	497

* Larger sizes available on request.

Main outline dimension (Class 600)

NPS (in)	Flanged Ends	Butt Weld Ends	RTJ Ends	Outline Dimension		Conduit	No Conduit
	L	L1	L2	H	D0	H2	H1
2	292	292	295	514	250	158	108
2 1/2	330	330	333	540	250	190	125
3	356	356	359	616	300	225	145
4	432	432	435	720	350	255	165
6	559	559	562	818	400	330	220
8	660	660	664	962	480	410	280
10	787	787	791	1150	600	490	330
12	838	838	841	1600	660	570	380
14	889	889	892	1775	700	650	430
16	991	991	994	2000	710	735	480
18	1092	1092	1095	2250	750	810	530
20	1194	1194	1120	2380	750	905	580
24	1397	1397	1407	2825	800	1010	660

* Larger sizes available on request.

Main outline dimension (Class 900)

NPS (in)	Flanged Ends	Butt Weld Ends	RTJ Ends	Outline Dimension		Conduit	No Conduit
	L	L1	L2	H	D0	H2	H1
2	368	368	371	473	300	158	108
2 1/2	419	419	422	570	300	190	125
3	381	381	384	630	350	225	145
4	457	457	460	725	350	255	165
6	610	610	613	915	400	330	220
8	737	737	740	1150	500	410	280
10	838	838	841	1416	550	490	330
12	965	965	968	1595	610	570	380
14	1029	1029	1038	2159	610	650	430
16	1130	1130	1140	2650	780	780	480

* Larger sizes available on request.

** Higher pressure classes available on request.

EXPANDING GATE VALVE

INTRODUCTION

The ***RANGER Expanding Gate Valve*** is similar in design to the slab gate valve for providing minimal pressure loss across the valve and a zero leakage seal, however in this design, the slab is a two-piece, expanding closing member which provides a simultaneous mechanical seal on the upstream/downstream seat rings, achieving a fully bi-directional, zero leakage seal with block, isolation and bleed capabilities as per API 6D in the fully close position; and double block and bleed capabilities in the fully open/close positions.

Perfect "through conduit" flow

As the expanding gate is expanded manually at the fully open/close positions through the operation of the hand wheel and internal mechanical stops, the higher the hand wheel torque is, a tighter seal is produced. As this type of valve does not rely on the line pressure to assist in sealing the seat rings to the slab gate, a tight, zero leak seal is achieved, at zero and at high/low differential pressures, regardless of vibrations and flexing of the valve body due to pipe line bending. When the expanding gate is moving between the open/close positions, the expanding gate is in the non-expanded position, whereby with the seat rings not being in contact with the expanding gate surface, the service life of the seat rings are greatly extended as well as the operating torques being much lower than the slab gate valve.

High Temperature Applications

This type of valve is used primarily for high temperature applications in refineries, for isolation valves in power plants, block valves in process systems and pipeline valves in critical areas.

Other features are the same as those for the slab gate valve, i.e., rising stem, stem sealing, bolted bonnet, seat ring design, seat sealing materials, fire safe design, seat/stem sealant injection, valve operators, drain plug and optional features.

EXPANDING GATE VALVE
KEY FEATURES

- API 6D design
- Full bore for pigging
- Extended seat ring seal service life
- Bi-directional, zero leak sealing at high/low pressures
- Block, isolation and bleed capabilities
- Internal/External cavity pressure relief system option
- Stem/Seat sealant injection
- Low operating torque
- Hard/Soft faced seat rings
- Anti blowout stem
- Position indicator rod
- Operator mounting flange as per ISO 5210
- Top entry for in-line maintenance
- Pressure range: Class 150 to 2500
- Pressure testing standard: API 6D
- Leakage rates: API 6D/ISO 5208
- Fire test: API 6FA
- Fugitive emission: API 624, MESC 77/312 - EPA 21
- Size range: 2" to 48" / DN50 to DN1200
- Temperature range:
    - -29°C to 190°C (-20°F to 374°F)
    - -46°C to 210°C (-50°F to 410°F)
    - higher temperature range available on request

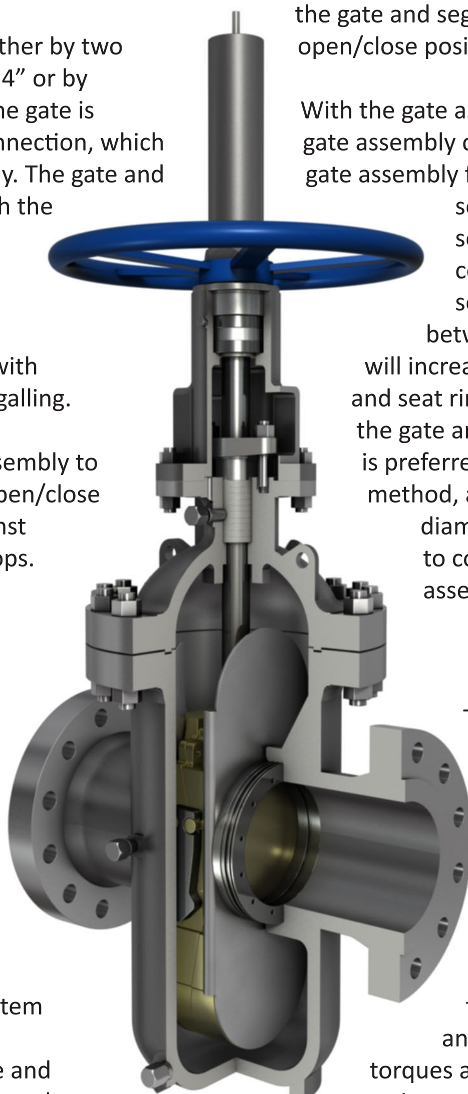
EXPANDING GATE VALVE

Valve Design Features

The expanding gate slab is constructed of two separate components, the gate and the segment. The inner faces of the gate and segment are machined with mating obtuse angles, so that when the gate moves laterally up or down, the gate will ride up the obtuse angle on the segment, causing the gate/segment to move away from each other, resulting in a parallel expansion in width of the gate assembly.

The gate and the segment are held together by two beam cantilever springs for valves up to 4" or by two gate centralizers on larger valves. The gate is connected to the stem by a "T" joint connection, which allows the gate assembly to float laterally. The gate and segment sealing faces are protected with the same hard-face materials as the gate valve for non-severe/severe service. For operating at very high pressures/ temperatures, the inner sliding faces of the gate and segment are protected with tungsten/chromium carbide to prevent galling.

The expanding gate enables the gate assembly to expand and achieve a tight seal in the open/close positions, when the segment stops against the upper/lower internal mechanical stops.



Operating Principle

When the gate assembly moves to the fully open/close position; the segment stops against an internal mechanical stop. As the hand wheel continues to be operated, the gate moves laterally up or down, causing the expanding gate assembly to expand in width until the gate sealing faces have made contact with the seat rings.

The higher the hand wheel torque and stem thrust are, the greater is the expanding mechanical advantage between the gate and segment, producing a tighter seal between the expanding gate assembly and the seat rings. Any increase or decrease in the line pressure will not affect the tight mechanical seal.

The two centralizers are placed on either side of the gate assembly and connect the gate and the segment together, whilst still allowing the gate and segment to move freely laterally up or down.

The centralizers are a mechanical device, whose main function is to work in conjunction with the skirt plates. With the two centralizers held vertically between the two skirt plates, this maintains the gate and segment in the fully retracted position while the gate assembly is travelling between the open/close positions, but the skirt plates will also allow the centralizers to swing and exit so that the gate and segment can expand just before the fully open/close position.

With the gate assembly fully retracted and as the gate assembly can float, this retraction prevents the gate assembly from any wedging action against the seat rings as well as preventing the sealing faces of the gate assembly from contacting and causing abrasion with the seat ring sealing faces during the travel between the open/close positions, which will increase the service life of the gate assembly and seat rings. This method of expanding/retracting the gate and segment on valves larger than 4" is preferred over the beam cantilever spring method, as the springs have to be of a larger diameter, requiring more hand wheel torque to compress at the ETC position, as the gate assembly becomes larger and heavier

Beam Cantilever Spring

The beam cantilever spring function is to maintain the gate and segment in the fully retracted position while the gate assembly is travelling between the open/close positions and to return the gate assembly to its original retracted position after the stem thrust on the gate has been released by turning the hand wheel. With this type of spring assistance, centralizers and skirt plates are not required. ETC torques are generally higher using this type of spring assistance than the centralizer and skirt plates, as the spring has to be compressed, however, as this design is only used on valves up to 4", the springs do not require a high hand wheel torque to compress them. The skirt plates are assembled either side of the gate assembly and centralized and held in position by the seat rings. The skirt plates have cut-outs on the edges at either the top/bottom, depending on which way the centralizers move to expand the gate assembly at the open/close position, which are machined to specific lengths, which allows the two centralizers to exit between the two skirt plates so that the gate and segment can expand just before the fully open/close position. The skirt plates other function is to keep the gate assembly vertically aligned with the seat rings due to its near proximity.

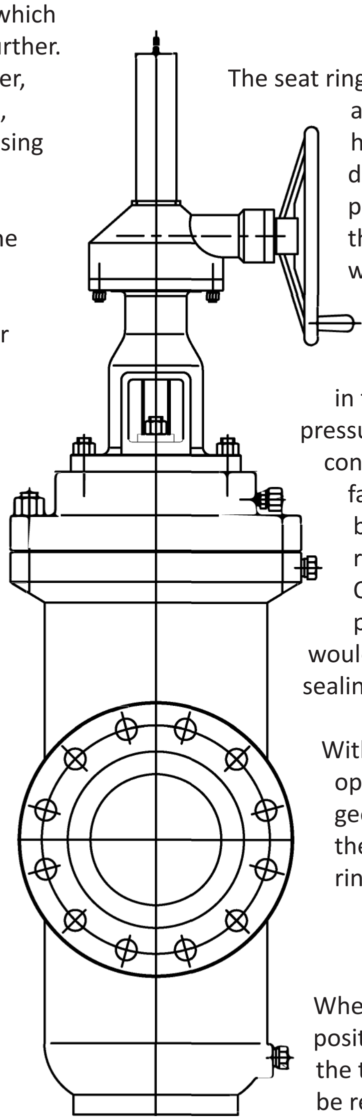
Gate Assembly in Close Position

Before reaching the fully closed position, the centralizer has disengaged from the skirt plates which allow the gate and segment to expand. As the hand wheel continues to be operated, the gate assembly moves downwards until the segment contacts the internal, lower stop, which prevents the segment from travelling any further. At this point the hand wheel is turned further, which through the stem-to-gate connection, the gate continues to move downwards causing the gate and segment to expand until they have contacted the seat rings, as the gate is forced against the mating wedge angle of the segment. To ensure that a zero leak seal is achieved, the hand wheel is turned further which expands the gate and segment tighter against the seat rings.

Gate Assembly in Mid Travel Position

When the hand wheel is operated to move the gate assembly from either the open/close to close/open position, the gate moves lateral up/down and towards the segment, which retracts the gate and segment sealing force away from the seat rings.

As the gate assembly starts to travel up/down, the centralizer engages with the skirt plates which maintains the gate and segment in the fully retracted position while the gate assembly is travelling between the open/close positions, preventing the gate assembly from any wedging action against the seat rings as well as preventing the sealing faces of the gate assembly from contacting and causing abrasion with the seat ring sealing faces.



Gate Assembly in Open Position

Before reaching the fully opened position, the centralizer has disengaged from the skirt plates which allow the gate and segment to expand. As the hand wheel continues to be operated, the gate assembly moves upwards until the segment contacts the internal, upper stop, which prevents the segment from travelling any further. At this point the hand wheel is turned further, which through the stem-to-gate connection, the gate continues to move upwards causing the gate and segment to expand until they have contacted the seat rings, as the gate is forced against the mating wedge angle of the segment.

To ensure that a zero leak seal is achieved, the hand wheel is turned further which expands the gate and segment tighter against the seat rings. In this position, the bore sized holes in the gate and segment aligns with the two seat rings and the valve bore, creating a perfect “through conduit” flow for the line medium with minimal turbulence, as well as isolating the body cavity from the line pressure.

Seat Ring: Seat Sealing

The seat ring design and soft/metal seat sealing materials are the same as those of the slab gate valve; however, the single piston effect (SPE) is designed not for body cavity self-relieving purposes but for maintaining the seat rings in the back of the seat pocket by the line pressure when the gate assembly is in the fully retracted position.

With the seat rings being kept permanently in the back of the seat pocket by the line pressure, the seat rings are prevented from contacting and causing abrasion with the sealing faces of the gate assembly, while it is travelling between the open/close positions. For this reason there are no springs or energized O-rings for assisting the seat rings for low pressure sealing, as either of these forces would push the seat rings against the gate assembly sealing faces.

With the gate assembly in the fully expanded, open/close position, the pressure distribution geometry of the seat rings are changed so that the line pressure is used for assisting the seat rings for high/low pressure sealing.

Body Cavity Relief System

When a tight seal is formed in the open/close position, any excess body cavity pressure caused by the thermal expansion of the liquid medium cannot be relieved into the upstream/downstream port by the SPE seat rings, as is possible with the gate design. This is due to the seat rings being held in the back of the seat pockets by the expanded gate assembly, which prevents any movement of the seat rings to relive the body cavity pressure. So that any excess body cavity pressure can be relieved, two external pressure relief systems are available - the check valve system or the pressure safety valve system.

Check Valve System

High pressure tubing is mounted on the outside of the valve body, connecting the body cavity to the upstream side of the valve. A check valve is installed between two needle valves in the tubing, so that the upstream line pressure keeps the check valve closed. The two needle valves must be kept open for this system to function. During normal valve operation, the upstream line pressure will keep the check valve closed, preventing any body cavity pressure from escaping. When the body cavity pressure exceeds the unseating pressure of the check valve, which is set not to exceed 33% of the line pressure, the excess pressure is relieved upstream. The two needle valves can be closed to isolate the line pressure, so that the check valve can be removed for maintenance or replacement. When using this system, the valve has a preferred upstream flow direction.

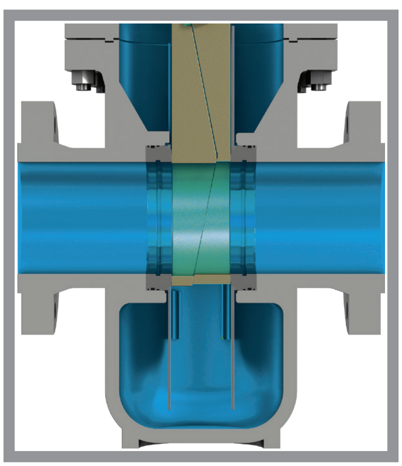
Pressure Safety Valve System

A pressure safety valve is mounted on the outside of the valve body, which can be connected to the body cavity via a direct drilling or high pressure tubing. When the body cavity pressure exceeds the unseating pressure of the pressure safety valve, which is set not to exceed 33% of the line pressure, the excess pressure is relieved externally and collected in a separate vessel. When using this system, the valve does not have a preferred upstream flow direction.

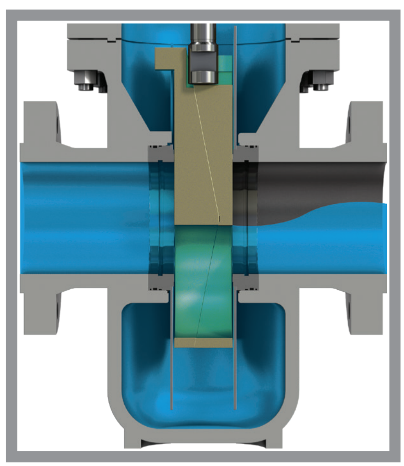
Isolation Valve Features

As per API 6D, this type of valve has the ability to isolate the valve against single/double pressure sources and to bleed/vent the body cavity of pressure for the purpose of testing the sealing integrity of the seats, sampling or removing debris. All of the following isolation types, Block and Bleed (BB) - Double Block and Bleed (DBB) - Double Isolation and Bleed (DIB) are achieved at once, irrelevant of a high/low differential pressure (DP), due to the seat rings being restricted from floating due to the expansion of the gate assembly in the close position.

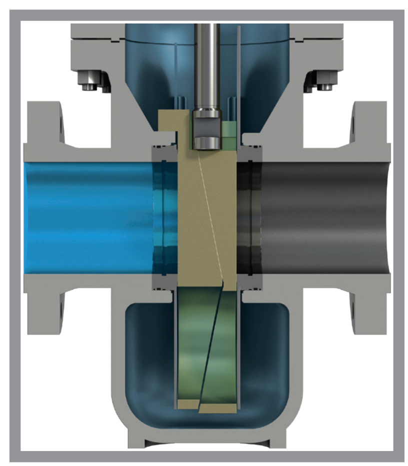
Double Expanding Wedge Mechanics



A When fully opened, it divides a pair of bevels on the combined wedges. Both sides of wedge press against the body sealing surface, preventing fluid and dirt from entering the body cavity.

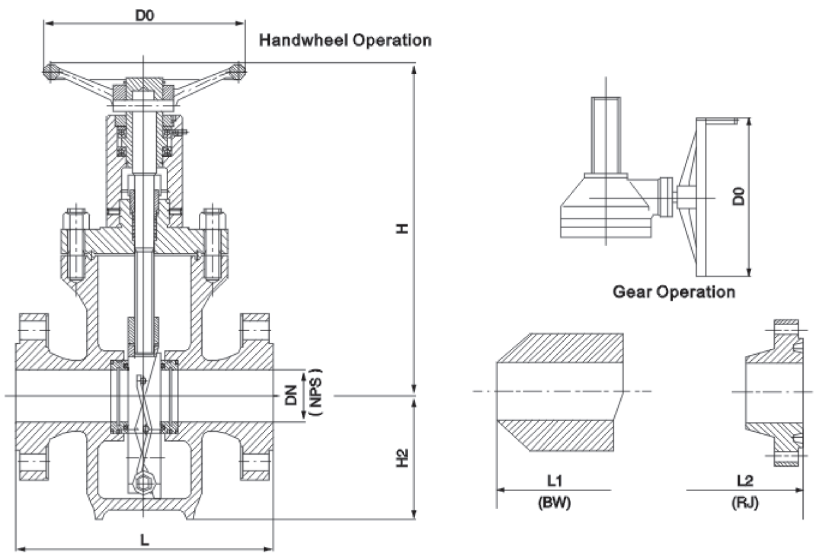


B During the process of opening or closing, both bevels of the main and minor wedges end up next to both sides of the wedge. There is a slight clearance with the body sealing surface, ensuring free movement of the wedge.



C When fully closed, it divides a pair of bevels below the combined wedges. Both sides of wedge press against the sealing surface, ensuring complete sealing of the valve.

Expanding Gate Valve Dimensions



Main outline dimension (Class 150)

NPS (in)	Flanged Ends	Butt Weld Ends	RTJ Ends	Outline Dimension		
	L	L1	L2	H	H2	D0
2	178	216	191	475	360	250
2 1/2	190	241	204	535	425	300
3	203	283	216	600	460	300
4	229	305	241	700	535	350
6	267	403	279	910	685	350
8	292	419	305	1095	815	350
10	330	457	343	1370	965	310
12	356	502	368	1470	1100	310
14	381	572	394	1730	1250	460
16	406	610	419	1870	1375	460

Main outline dimension (Class 300)

NPS (in)	Flanged Ends	Butt Weld Ends	RTJ Ends	Outline Dimension		
	L	L1	L2	H	H2	D0
2	216	216	232	475	360	250
2 1/2	241	241	257	535	425	300
3	283	283	298	600	460	300
4	305	305	321	700	535	350
6	403	403	419	910	685	350
8	419	419	435	1085	815	350
10	457	457	473	1370	965	310
12	502	502	518	1470	1100	310
14	762	762	778	1730	1250	460
16	838	838	854	1870	1375	460

Main outline dimension (Class 600)

NPS (in)	Flanged Ends	Butt Weld Ends	RTJ Ends	Outline Dimension		
	L	L1	L2	H	H2	D0
2	212	212	295	499	378	300
2 1/2	330	330	333	562	446	350
3	356	356	359	630	483	350
4	432	432	435	735	562	400
6	559	559	562	958	720	500
8	660	660	664	1150	856	310
10	787	787	791	1439	1013	310
12	838	838	841	1545	1155	460
14	889	889	892	1817	1313	460
16	991	991	994	1965	1445	610

Main outline dimension (Class 900)

NPS (in)	Flanged Ends	Butt Weld Ends	RTJ Ends	Outline Dimension		
	L	L1	L2	H	H2	D0
2	368	368	371	499	378	300
2 1/2	419	419	422	562	446	350
3	381	381	384	630	483	350
4	457	457	460	735	562	400
6	610	610	613	958	720	500
8	737	737	740	1150	856	310
10	838	838	841	1439	1013	310
12	965	965	968	1545	1155	460

* Higher pressure classes available.

Design standards

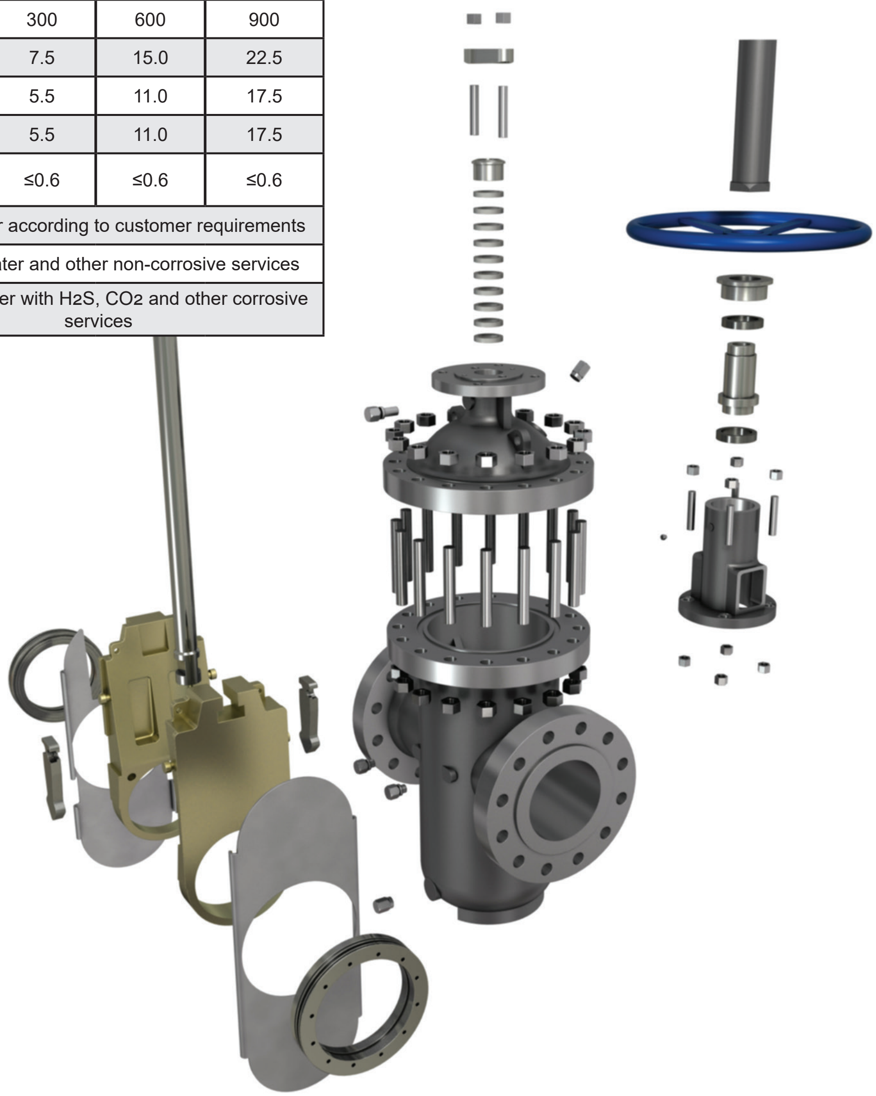
Design Reference		API
Design Standard		API 6D ASME B16.34
Face-to-face Dimension	**Flanged Ends**	API 6D ASME B16.10
	Welded Ends	
Adapting Flange		ASME B16.34 MSS SP44
Butt Weld Ends		ASME B16.25
Testing and Inspection		API 6D ISO 5208

Note: The flange connection dimension can be designed and manufactured as per customer requirements.

Product performance specification

Pressure Rating Range		ASME Class*			
		150	300	600	900
Test Pressure at Normal Temperature 38 °C (MPa)	Shell Test	3.0	7.5	15.0	22.5
	Left Sealing	2.2	5.5	11.0	17.5
	Right Sealing	2.2	5.5	11.0	17.5
	Low Pressure Air Seat	≤0.6	≤0.6	≤0.6	≤0.6
Applicable Temperature		-46~210°C or according to customer requirements			
Applicable Service	Standard Service	Oil, Gas, Water and other non-corrosive services			
	Sour Service	Oil, Gas, Water with H_2S, CO_2 and other corrosive services			

* Higher pressure classes available on request.



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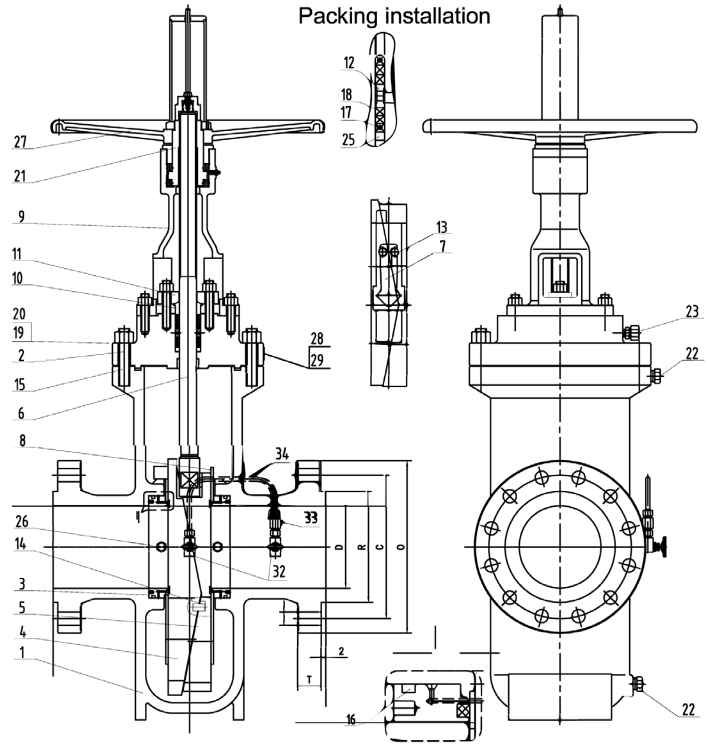

Key Components

Item	Part Name	Material
		Sour Service*
		ASTM
1	BODY	A216 WCC
2	BONNET	ASTM A105
3	SEAT	A105+ENP+ RPTFE
4	WEDGE I	A216 WCB+ENP
5	WEDGE II	A216 WCB+ENP
6	STEM	A182 F6a
7	LEVER	AISI 1035
8	GUIDE PLATE	A276 304
9	YOKE	A216 WCC
10	PACKING BUSHING	A276 410
11	PACKING PLATE	A216 WCC
12	LANTERN RING	A276 410
13	SCREW	A193 B7M
14	PIN	CS
15	F.S.GASKET	304+GRAPHITE
16	0-RING	Vitan or HNBR
17	F.S.GASKET	304+GRAPHITE
18	F.S.GASKET	304+GRAPHITE
19	BOLT	A193 B7M
20	NUT	A194 2H
21	STEM NUT	A439 D-2C
22	HEX PLUG	CS+Zn
23	INJECTION VAL VE	CS+Zn
25	PACKING WASHER	A276 410
26	LUBRICATION PORT	CS+Zn
27	HANDWHEEL	A216 WCC
28	NAMEPLATE	A276 304
29	RIVET	SS
32	NEEDLE VALVES	SS
33	CHECK VALVE	SS
34	TUBING	SS

Note: The main valve components shall be designed and selected as per working conditions of customer requirements. Low-temp. materials available as required.

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VALVE AMERICA