Bonnets, Metal Bellows Seals, Bonnet Flanges, Bolting, Packing and Guides

INTRODUCTION

The proper selection of bonnet, flanges, bolting, packing and guides is important to the operation of any control valve. In addition, many applications require that a low leakage packing system be installed in the valve to prevent the fugitive emissions of process fluids.

This section has two parts. The first part describes Valtek's globe body valves. The second part (beginning on page 12-12) describes Valtek's rotary valves.

GLOBE VALVES

BONNET MATERIALS

Bonnets are normally manufactured from the same material as the body. Table 12-1 provides the standard bonnet material for a given body material:

Table 12-I:
Standard Globe Body/Bonnet Materials

Body Material	Bonnet Material
Carbon Steel	Carbon steel bar A675-70 thru 12-inch*
Stainless Steel	Stainless steel bar A479-316 thru 12-inch*
Chrome-moly	Standard – stainless steel bar A479-316; option – Chrome-moly forging equivalent to body material
Alloys	Bar or forging equivalent to the body material

* Valves larger than 12-inch are normally manufactured with bonnets fabricated from plate and bar or from a forging equivalent to the body material.

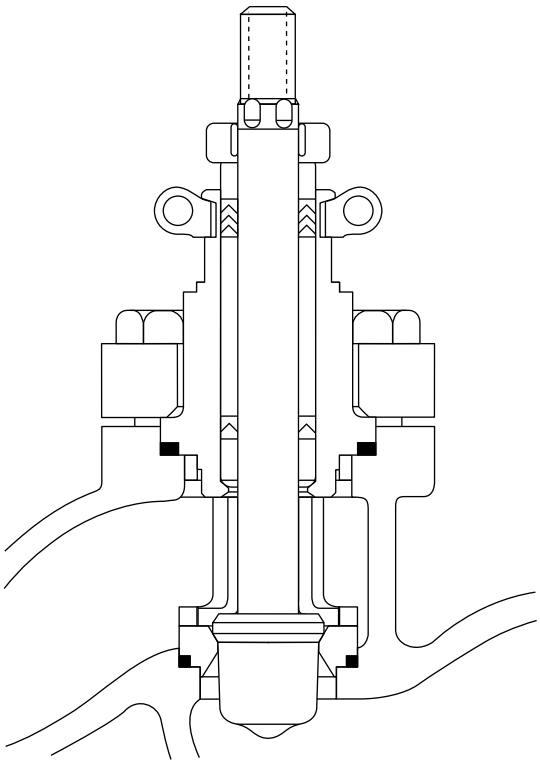


Figure 12-1: Standard Bonnet

BONNET TYPES

Standard Bonnet

Valtek's standard bonnet is usually constructed of the same material as the body. It handles temperatures from -20 degrees to 750 degrees Fahrenheit, depending on the packing used. In some cases, class 900 - 2500 standard bonnets can be rated as high as 800 degrees Fahrenheit, depending on the packing used.

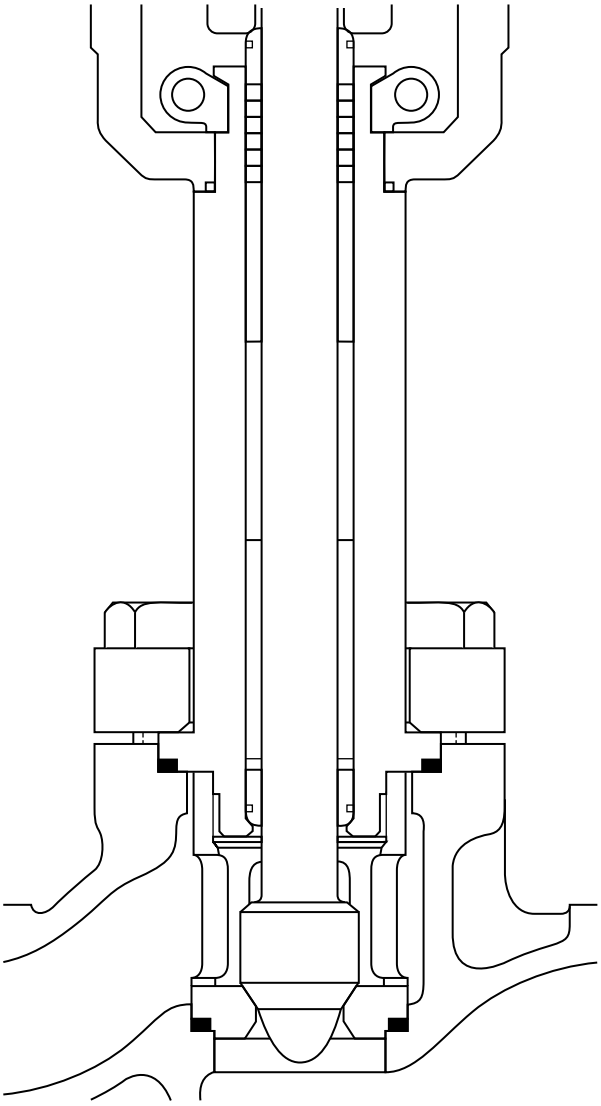


Figure 12-2: Extended Bonnet

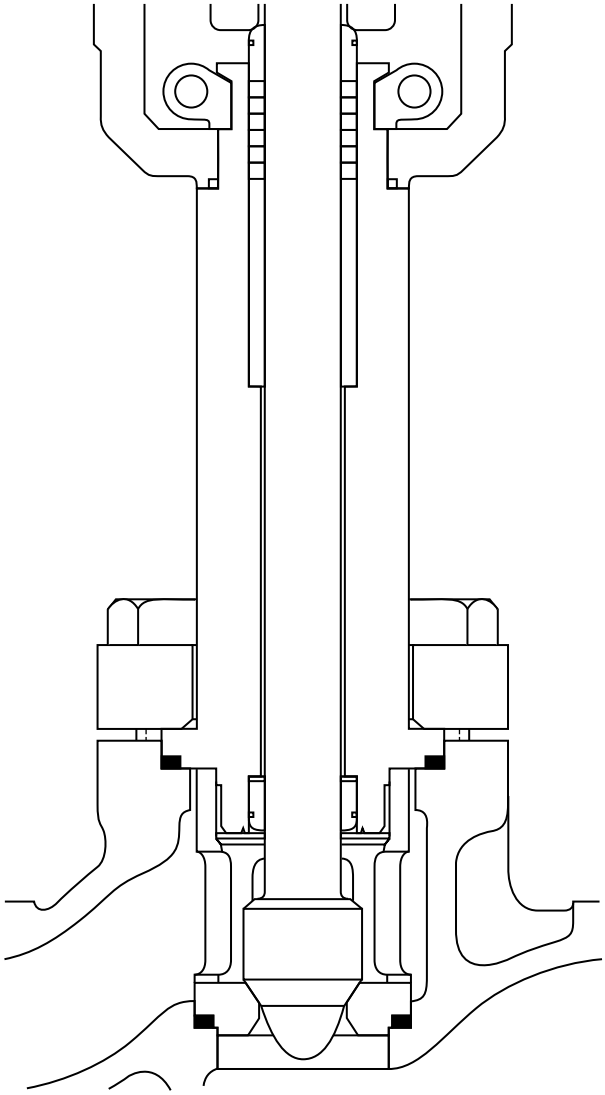


Figure 12-3: Cryogenic Extended Bonnet

Extended Bonnet

The extended bonnet protects the packing and actuator soft goods from excessive heat or cold which may inhibit packing or actuator performance. It is constructed from carbon steel for temperatures from -20 to 800 degrees Fahrenheit, and from 304 or 316 stainless steel for temperatures from -150 to 1500 degrees Fahrenheit. For continuous cryogenic applications, a cryogenic extended bonnet should be used.

Cryogenic Extended Bonnet

The cryogenic extended bonnet permits stagnant, moderate temperature gas to form in the bonnet, which acts as an insulator to minimize heat transfer. This design also protects the packing from the extremely low temperature of the service fluid. It is usually manufactured from 304 or 316 stainless steel and handles temperatures down to -423 degrees Fahrenheit. Standard construction consists of stainless steel bonnet flange and bolting.

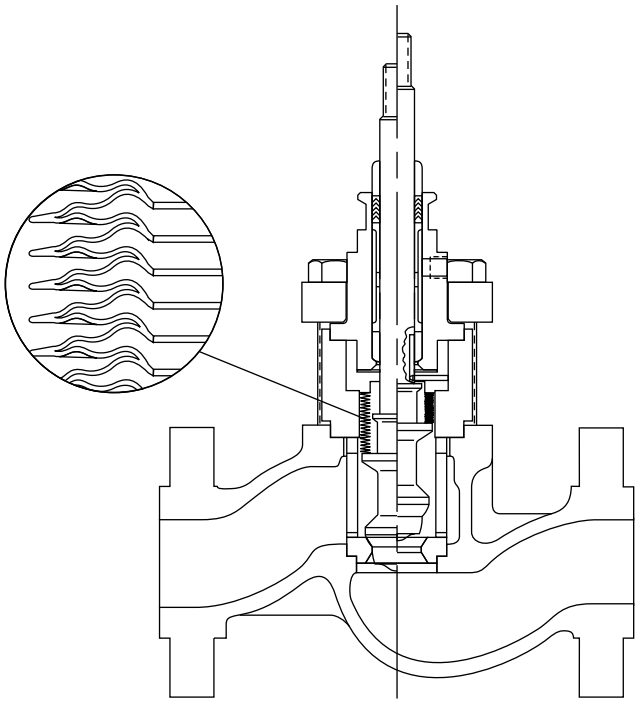


Figure12-4: Guardian Metal Bellows Seal

METAL BELLOWS SEAL

A metal bellows seal can be encased either in the body or in an extended bonnet for those services where fluid leakage to atmosphere needs to be totally eliminated.

Guardian Metal Bellows

The Guardian standard metal bellows seal – which is encased in the body – uses a standard bonnet, as shown in Figure 12-4. Four sizes and two pressure ratings are available for temperatures up to 650 degrees Fahrenheit.

The metal bellows are rated either by pressure, temperature or cycle life. Pressure ratings can be increased by reducing the calculated cycle life. Conversely, cycle life can be lengthened by reducing the operating pressures.

The Guardian bellows is in a relaxed state at the valve's closed position. The stroke length has been reduced from that of a standard Mark One to increase the life of the bellows. External pressure is used to balance the pressure load on the bellows. An anti-rotation pin prevents accidental rotation of the seal. A "tell-tale" tap in the standard bonnet provides early indication of bellows failure, should the bellows rupture.

The standard metal bellows is constructed from Inconel 625. It is also available in Hastelloy and other weldable materials.

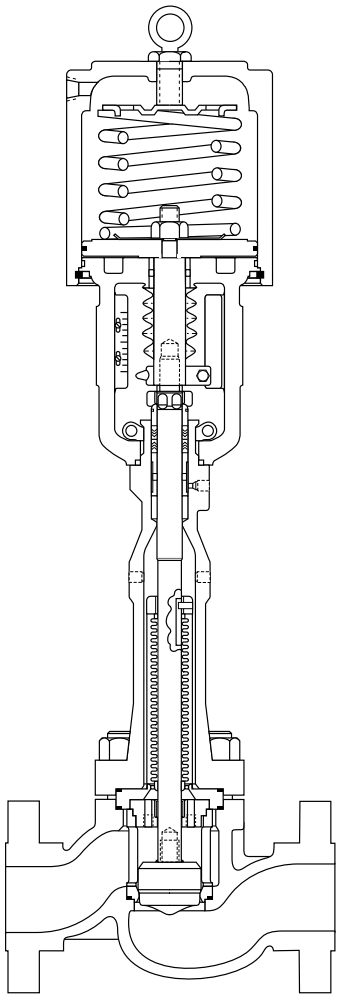


Figure12-5: Guardian II Metal Bellows Seal

Guardian II Metal Bellows Seal

The Guardian II Metal Bellows Seal uses a formed bellows design with minimal welded joints. A full-cycle life of up to 5 million cycles can be expected while operating in process temperatures from -320° to 1000° Farenheit and pressures to 1100 psi. Inconel 625 is the standard material for the bellows assembly with Hastelloy C-22 as optional.

The bellows assembly is encased in a shroud, which acts as a pressure boundary in the service. This design allows a single, pressurized gasket seal and prevents fluid contact with the bellows housing during normal operation. External pressurization of the bellows increases cycle life and the maximum allowable operating pressure. At the same time "bellows squirm" is eliminated. The replaceable plug head allows trim changes without changing the bellows assembly. The Guardian II design includes an anti-rotation pin to prevent the plug and bellows assembly from rotating, and a tell-tale tap that indicates bellows leakage. Additional monitoring ports in the bellows assembly housing are available.

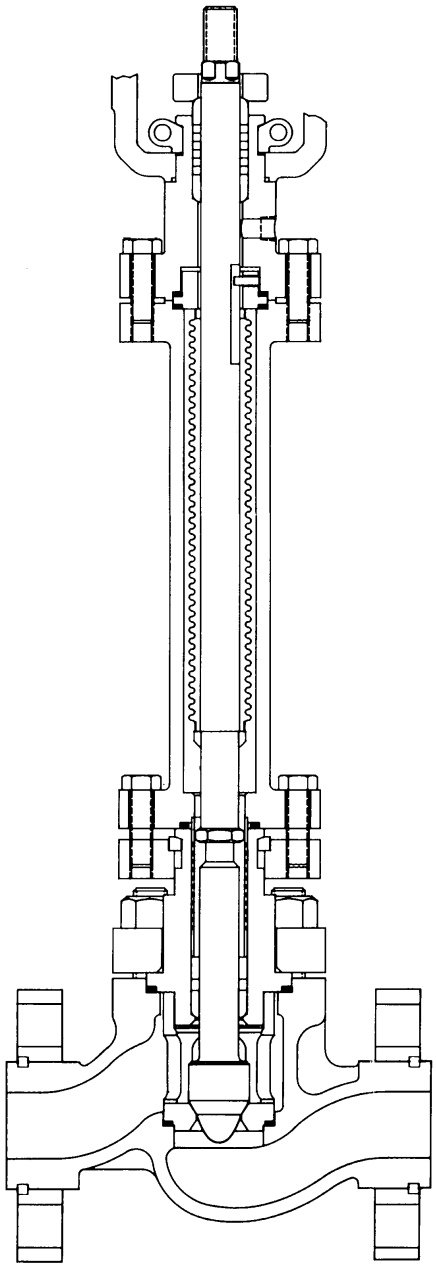


Figure 12-6: Formed Metal Bellows Seal Extended Bonnet

Formed Metal Bellows Seal

Valtek also offers a formed (or rolled) bellows that is encased in an extended bonnet, as shown in Figure 12-6. It is rated for operation at 150 psi at 100 degrees Fahrenheit or 90 psi at 600 degrees Fahrenheit. Special designs are available for pressures to 2900 psi at 100 degrees Fahrenheit and temperatures to 1100 degrees Fahrenheit at 150 psi.

Since bellows seals are designed for special service conditions and not to a particular design class, it is necessary to include complete and accurate service conditions when specifying.

Bonnet Flange and Bolting Material

Table 12-II provides Valtek's standard bonnet flanges and bolting materials for Mark One, Mark Two, Tek-Check and Mark Eight globe valves. Table 12-III lists specific temperature limitations and material specifications for bonnet flange bolting.

Table 12-II: Globe Valve Bonnet Flange and Bolting Materials

Body Sizes and Rating	Standard Bonnet	Optional Flange	Standard Bolting	Optional Bolting
1/2 to 3-inch: Class 150-600;	Carbon steel	Stainless steel (1); same alloy as body	SAE grade 5	300 Series cap screws (1); B7, 2H studs and nuts (2); 304 and 316 stainless steel studs and nuts (3, 4)
4-inch: Class 150-600; 6-inch and above: Class 150 - 600; all high pressure sizes	Carbon steel	Stainless steel (1); same alloy as body.	B-7, 2H studs and nuts (2)	304 and 316 stainless steel studs and nuts (1,3)

(1) Alloy flange & bolting material required only when pressure or temperature limits of the standard carbon steel or B7, 2H materials are insufficient.
(2) Temperature limit of -20 to 800 degrees Fahrenheit, depending on body limitation.
(3) Temperature limit of -425 to 1500 degrees Fahrenheit, depending on body limitation.
(4) Other alloys depending on design criteria.

Table 12-III: Bolting Temperature Limitations

Body Material	Temperature (°F)	Bolt Material	Nut Material
Carbon Steel (Grade WCB)	-20 to 800	ASTM A193 Gr B7	ASTM A194 Gr 2H
Carbon Steel Grade LCB)	-50 to 650	ASTM A193 Gr B7	ASTM A194 Gr 2H
Carbon Moly (Grade WC1)	-20 to 800 801 to 850	ASTM A193 Gr B7 ASTM A193 Gr B7	ASTM A194 Gr 2H ASTM A194 Gr 7
1 1/4 Cr-1/2 Mo (Grade WC6)	-20 to 800 801 to 1000	ASTM A193 Gr B7 ASTM A193 Gr B7	ASTM A194 Gr 2H ASTM A194 Gr 7
2 1/4 Cr-1 Mo (Grade WC9)	-20 to 800 801 to 1000 1001 to 1050	ASTM A193 Gr B7 ASTM A193 Gr B7 ASTM A193 Gr B16	ASTM A194 Gr 2H ASTM A194 Gr 7 ASTM A194 Gr 7
5 Cr-1/2 Mo (Grade C5)	-20 to 800 801 to 1000 1001 to 1100	ASTM A193 Gr B7 ASTM A193 Gr B7 ASTM A193 Gr B16	ASTM A194 Gr 2H ASTM A194 Gr 7 ASTM A194 Gr 4
9 Cr-1 Mo (Grade C12)	-20 to 800 801 to 1000 1001 to 1100	ASTM A193 Gr B7 ASTM A193 Gr B7 ASTM A193 Gr B16	ASTM A194 Gr 2H ASTM A194 Gr 7 ASTM A194 Gr 4
Type 304 (Grade CF8)	-425 to 100 100 to 1500	ASTM A320 Gr B8 *ASTM A193 Gr B8	ASTM A194 Gr 8 *ASTM A194 Gr 8
Type 347 (Grade CF8C)	-425 to 100 100 to 1500	ASTM A320 Gr B8 *ASTM A193 Gr B8	ASTM A194 Gr 8 *ASTM A194 Gr 8
Type 316 (Grade CF8M)	-325 to 100 100 to 1500	ASTM A320 Gr B8 *ASTM A193 Gr B8M	ASTM A194 Gr 8 *ASTM A194 Gr 8M
3 1/2 Ni (Grade LC3)	-150 to -50 -50 to 650	ASTM A320 Gr L7 ASTM A193 Gr B7	ASTM A194 Gr 4 w/Charpy Test or 8M ASTM A194 Gr 2H

* Alloy steel bolting, A193 Gr B7 bolts and A194 Gr 2H nuts can be used at moderate temperatures depending on the permissible differential expansion.

PACKING AND PACKING BOX

Standard Valtek packing boxes are deeper than most conventional types. The spacing between the wiper set and the main upper packing set prevents contamination of the upper packing. The upper set is positioned far enough away from the wiper set to avoid contact with any part of the plug stem, which has been exposed to the flowing medium. The wiper set is designed to minimize the amount of fluid on the plug stem.

The deep packing box is designed to permit a wide variety of packing configurations, including twin seal packing, without changing bonnets. Figure 12-7 shows the common packing box configurations.

Two widely-spaced stem guides – used with a large plug stem diameter – provide exceptional guiding. The upper stem guide also acts as a packing follower. The lower guide is situated close to the plug head for additional guiding support, ensuring accurate alignment of the seat ring and plug.

Packing configurations can include twin seals where equal amounts of packing are used at both ends of the packing box. This configuration is usually specified when a vacuum seal or lubrication is required. However, twin packing does not improve the sealing capability of the packing, and in some cases may hamper its performance. Lantern rings are provided between the packing sets if stem lubrication is required.

Valtek's standard packing is the Teflon V-ring. This design provides a tight seal at the feather edge of each ring with a minimum amount of stem friction. To achieve a tight seal with Teflon, the packing box bolting is tightened to just over finger-tight. The major limitations of Teflon are its low service temperature limit of approximately 500 degrees Fahrenheit with a standard bonnet and its "creep" characteristics, which decrease its sealability under load.

Other available packing materials include PTFE braided, glass-filled Teflon, graphite/asbestos-free packing (AFP), (Inconel reinforced AFP) and Grafoil. Graphite/AFP, and Grafoil are usually used in high temperature applications.

Table 12-IV shows packing temperature limitations for both standard and extended bonnets. Table 12-V provides the minimum temperature limitations for packing used with cryogenic extended bonnets. Figures 12-8, 12-9 and 12-10 provide pressure/temperature curves for Teflon TFE, glass-filled Teflon and carbon-filled Teflon asbestos. Table 12-VI provides the stem packing friction forces.

Vacuum Service Packing

When the process fluid is at a vacuum pressure (below atmospheric pressure), special consideration must be given to the packing configuration. Normally V-rings are used since they seal the best. Although Teflon is the most often used material, other packing materials may be used depending on the process temperature and pressure. Valtek has three available packing options.

1. If the process is always under a vacuum, a standard V-ring packing may be used with the top set of V-rings being inverted (chevron facing away from the plug head.)
2. If the process pressure is both vacuum and positive at various times, the packing needs to seal both directions. Twin V-ring packing is best used, inverting the top set (chevrons facing away from the plug head) with the bottom set being installed normal.
3. When a vacuum seal is needed on the bonnet independent of the process pressure, a purge connection with a lantern ring spacer is available with either of the above configurations. This configuration allows the application to be monitored.

Fugitive Emissions Packing

When special packing is required to keep emissions through packing at a low level, SafeGuard and SureGuard packing sets are used. SafeGuard and SureGuard packing sets are available for new valves or may be retrofitted into existing Valtek bonnets to provide exeptional leakage control, reliability and longevity. Both systems are available in standard and twin configurations. See Figure 12-7.

SafeGuard is a Teflon based, V-ring packing set that utilizes the sealing ability of virgin Teflon while minimizing the effects of creep. This is accomplished by backing up the virgin V-rings with carbon-filled Teflon (to prevent extrusion and cold flow) and live loading the entire set to compensate for any Teflon creep due to thermal gradients or wear. Figure 12-8 illustrates the pressure/temperature curve for SafeGuard.

SureGuard is a Kalrez based, V-ring packing set that utilizes the exceptional sealing ability of a perfluorelastomer while maintaining the inertness equivalent of Teflon. Like SafeGuard, the sealing rings are backed up by carbon-filled Teflon to prevent extrusion and increase the life of the packing set. SureGuard XT is a similar packing set with PEEK backup rings, which has the capability to endure temperatures up to 550 degrees Fahrenheit in a standard bonnet, and up to 800 degrees Fahrenheit in a high-pressure, extended bonnet. Figures 12-8, 12-9 and 12-10 illustrates the pressure/temperature curve for SureGuard and SureGuard XT.

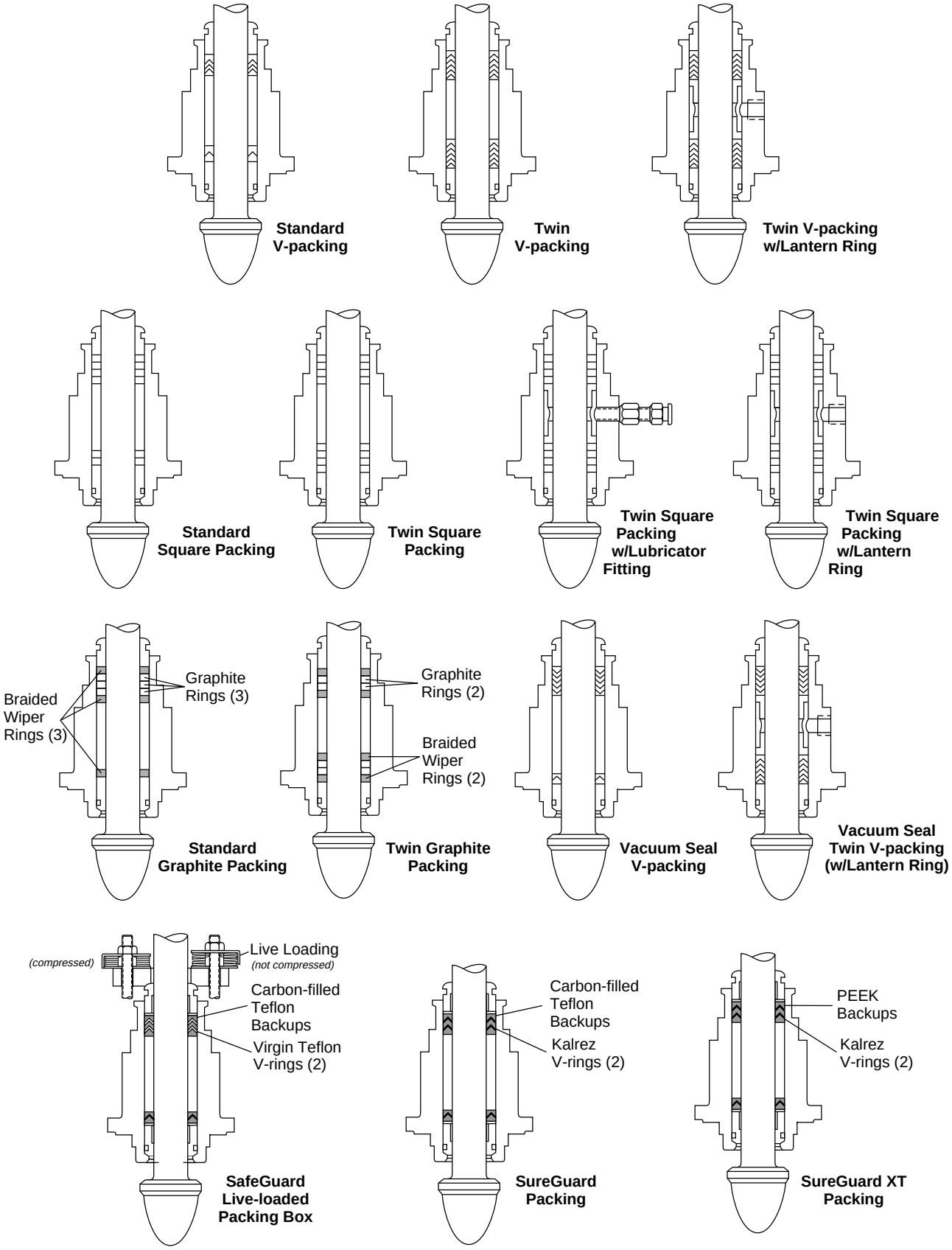


Figure 12-7: Typical Linear Valve Packing Configurations

Table 12-IV: Packing Temperature Limitations, Standard and Extended Bonnets

Valve ANSI Rating	Packing Material/Type	Standard Bonnet (1) (degrees F*)	Extended Bonnet (1) (degrees F)	Pressure Limits
150 - 600	Teflon TFE	-20 to 450	-150 (2) to 600	Figure 12-8
	Braided PTFE (3) Glass-filled Teflon	-20 to 500		
150 - 600	Asbestos-free packing AFPI (5)	-20 to 750 (4)	-20 to 1200	Body rating
150 - 600	Grafoil (6)	-20 to 750 (4)	-20 to 1500	Body rating
900 - 2500	Teflon TFE	-20 to 450	-150 (2) to 700	Figure 12-9
	Teflon w/braided PTFE Glass-filled Teflon	-20 to 500		
900 - 2500	Asbestos-free packing AFPI (5)	-20 to 800	-20 to 1200	Body rating
900 - 2500	Grafoil (6)	-20 to 800	-20 to 1500	Body rating
150 - 600	SafeGuard	-20 to 450	-20 to 600	Figures 12-7, 12-8
150 - 600	SureGuard	-20 to 450	-20 to 600	Figures 12-7, 12-8
150 - 600	SureGuard XT	-20 to 550	-20 to 700	Figures 12-7, 12-8
900 - 2500	SafeGuard	-20 to 450	-20 to 700	Figures 12-7, 12-9
900 - 2500	SureGuard	-20 to 450	-20 to 700	Figures 12-7, 12-9
900 - 2500	SureGuard XT	-20 to 550	-20 to 800	Figures 12-7, 12-9

(1) ANSI B16.34 specifies acceptable pressure/temperature limits for pressure retaining materials. Consult factory for additional information.
(2) If the appropriate body and bonnet materials are used.
(3) PTFE is rated to -423 degrees Fahrenheit.
(4) 8 to 12-inch, Class 150 - 600; and 3 to 12-inch, Class 900 - 2500 can be used to 850 degrees Fahrenheit.
(5) Asbestos-free, high temperature packing.
(6) Do not use Grafoil above 800 degree Fahrenheit in oxidizing service such as air.

* Fluid temperatures; see Figures 12-8, 12-9 and 12-10.

Table 12-V: Minimum Globe Valve Packing Temperatures, Cryogenic Extended Bonnets

Valve ANSI Rating	Packing Material	Extension Length (inches)	Temperature Limits (1) (degrees F)	Pressure Limits
150 - 600	Teflon TFE	15	-320	Body rating
	Braided PTFE	18	-350	
		24	-423	

(1) ANSI B16.34 specifies acceptable pressure/temperature limits for pressure retaining materials. Consult factory for additional information.

Maximum Fluid Temperature/Pressue Curves for Valve Packing

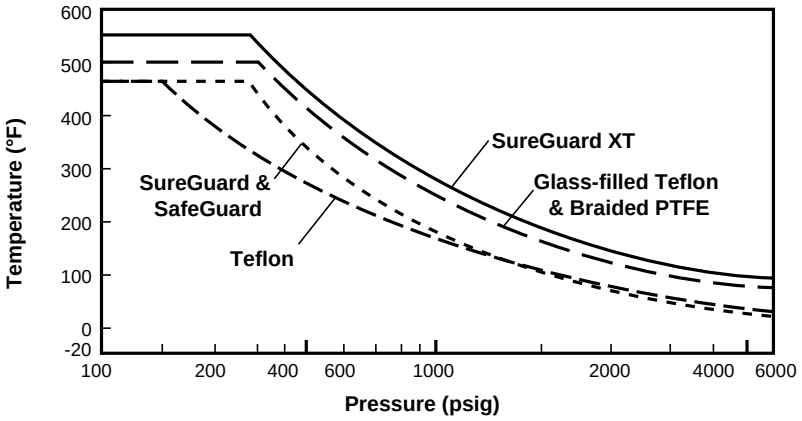


Figure 12-8: Standard Packing Box

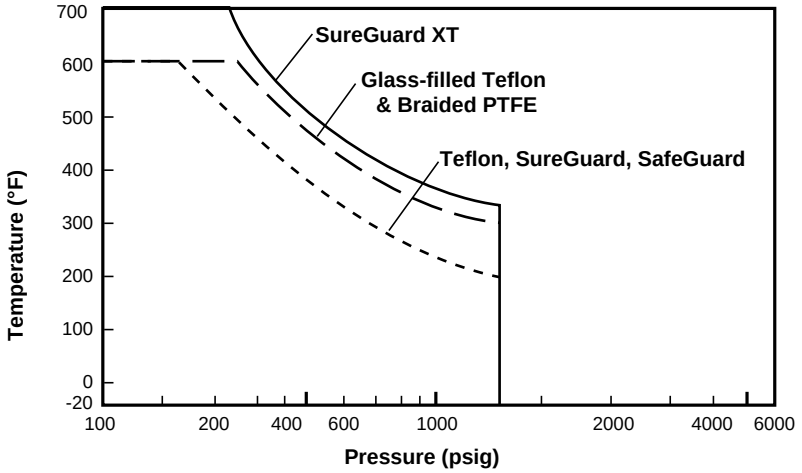


Figure 12-9: Extended Bonnet / Extension, Class 150 - 600

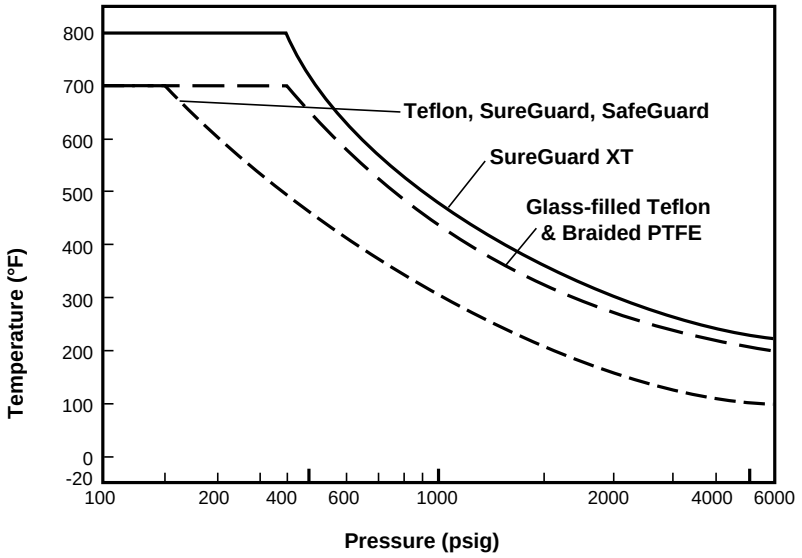


Figure 12-10: Extended Bonnet, Class 900 - 2500

Table 12-VI: Typical Globe Valve, Stem Packing Friction Forces

NOTE: *All numbers are in pounds-force*

Plug Stem Diameter* (inches)	Teflon Single V	Teflon Twin V	Glass and Carbon-filled Teflon	Std. Grafoil	Twin Grafoil	Braided PTFE	Braided AFP	SafeGuard SureGuard Single V	SafeGuard SureGuard Twin V
0.56	44	49	45	356	642	44	271	52	68
0.88	49	54	63	560	842	49	344	70	89
1.12	54	60	78	712	1001	54	399	85	106
1.50	64	72	103	954	1239	64	486	111	135
2.00	82	93	141	1272	1557	82	600	149	177
2.50	105	120	184	1590	1875	105	714	192	225
3.00	133	153	232	1908	2193	133	829	239	279

* See Table 12-VII for plug stem diameter versus valve size.

Table 12-VII: Plug Stem Sizes for Given Valve Sizes (inches)

Valve Size	Rating Class	Full Area Trim Size	Unbalanced Trim		Pressure-balanced Trim	
			Stem Diameter	Stem Area (sq.in.)	Stem Diameter	Stem Area (sq.in.)
1/2	150-600	.50	.562	.248	–	–
3/4	150-2500	.72	.562	.248	–	–
1	150-1500	.81	.562	.248	–	–
	2500	.72	.562	.248	–	–
1 1/2	150-1500	1.25	.875	.601	.562	.248
	2500	1.00	.875	.601	.562	.248
2	150-1500	1.62	.875	.601	.562	.248
	2500	1.25	.875	.601	.562	.248
3	150-600	2.62	1.125	.99	.875	.601
	900-1500	2.62	1.5	1.77	.875	.601
	2500	2.00	1.125	.99	.875	.601
4	150-600	3.50	1.125	.99	.875	.601
	900-1500	3.50	1.5	1.77	1.125	.994
	2500	2.62	1.5	1.77	1.125	.994
6	150	5.00	1.125	.99	1.125	.994
	300-1500	5.00	2.00	3.14	1.5	1.77
	2500	4.00	2.00	3.14	1.5	1.77
8	150	6.25	1.5	1.77	1.5	1.77
	300-600	6.25	2.00	3.14	1.5	1.77
	900-1500	6.25	2.5	4.91	2.0	3.14
	2500	5.00	2.5	4.91	2.0	3.14
10	150	8.00	2.00	3.14	–	–
	150-600	8.00	–	–	2.0	3.14
	300-600	8.00	2.5	4.91	–	–
	900-1500	8.00	3.0	7.07	2.5	4.91
	2500	6.25	3.0	7.07	2.5	4.91
12	150	9.50	2.0	3.14	2.5	4.91
	300-600	9.50	3.0	7.07	2.5	4.91
	900-2500	8.00	3.0	7.07	2.5	4.91
	900-1500	9.50	–	–	2.5	4.91
	2500	8.00	–	–	2.5	4.91
14	150	11.00	3.0	7.07	2.5	4.91
	300-600	11.00	3.0	7.07	3.0	7.07
	1500	11.00	–	–	3.0	7.07

GUIDES

Standard Guides

When selecting guide materials, the prioritized list below should be used:

a. Grafoil-lined stainless steel*
b. Glass-filled Teflon lined stainless steel*
c. Solid bronze guide
d. Solid stellite guide

* The standard guide retainer material is stainless steel. In alloy valves the guide retainer is constructed of the same material as the body.

Grafoil Guides

Versatile Grafoil guides can be used in many applications. The following applies to Grafoil guides.

- 1/2 – 2-inch Valve Size

  Pressures to 1000 psig
  Temperatures to 1500° F
  Pressure drops to 250 psid

  Exceptions

  Maximum temperature 800° F on oxydizing or air service

  Do NOT use in cavitating conditions, or pressure drops over 250 PSID, or oxygen enriched services

- 3 – 4-inch Valve Size

  Pressures to 600 psig
  Temperatures to 1500° F
  Pressure drops to 200 psid

  Exceptions

  Maximum temperature 800° F on oxydizing or air service

  Do NOT use in cavitating conditions or pressure drops over 200 PSID, or oxygen enriched services

- 6-inch Valve Size & Larger

  Pressures to 500 psig
  Temperatures to 1500° F
  Pressure drops to 100 psid

  Exceptions

  Do NOT use in cavitating conditions or pressure drops over 100 PSID, or oxygen enriched services

Glass-Filled Teflon Guides

Glass-filled Teflon guides consist of a glass-filled Teflon liner and a metal retainer.

These guides are suitable for most chemical applications if the temperature and pressure fall within the limits shown in Figure 12-11.

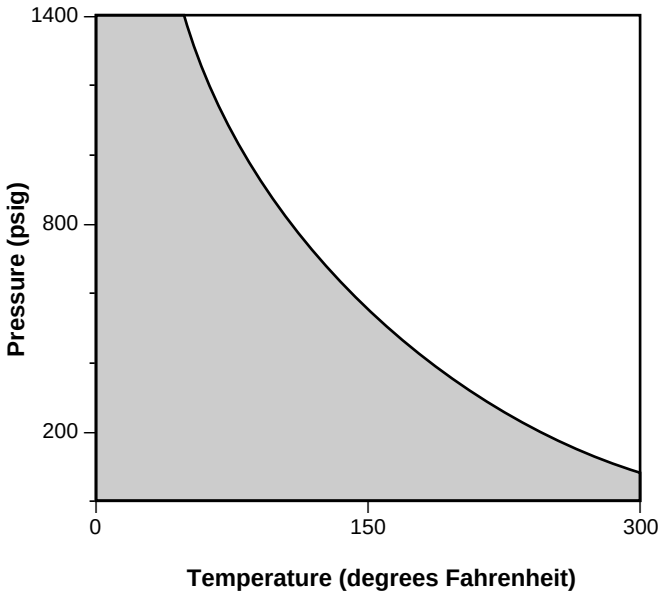


Figure 12-11: Pressure vs. Temperature Limitations, Glass-filled Teflon Guides

Solid Bronze Guides

Bronze guides may be used in valve applications up through class 2500. Temperature of the fluid should not exceed 500 degrees Fahrenheit for the lower guide. Temperature of the fluid should not exceed 900 degrees Fahrenheit for the upper guide.

These guides are principally used in water service and in valves which require a high degree of cleanliness such as oxygen or hydrogen service valves.

Bronze guides should not be used: 1) where corrosion exists; 2) in cavitating service where the pressure drop exceeds 400 psi for valves 1/2 through 4-inch and 250 psi for valves 6-inch and larger, or; 3) in valves requiring N.A.C.E certification.

Stellite Guides

Stellite guides are suitable for all valves through class 2500 and to temperatures through 1500 degrees Fahrenheit.

A Stellite lower guide is normally supplied for valves such as ChannelStream, Tiger-Tooth, CavControl and some pressure-balance applications. A Stellite lower guide is used in choked flow at differential pressures greater than that allowed with Grafoil, Teflon or bronze guides.

The lower guide area on the plug stem that comes in contact with the Stellite guide must be Stellited if the base trim material is a 300 series stainless steel.

ROTARY VALVES

Rotary Valve Bodies

All Valtek rotary valve body designs include a bonnet. Valtek rotary valve bodies normally handle temperatures from -20 degrees to 750 degrees Fahrenheit, depending on the packing used. In some cases, class 900 – 2500 bodies can be rated as high as 800 degrees Fahrenheit, depending on the packing used.

Table 12-VIII:
Rotary Body/Extension Materials

Body Material	Bonnet Material
Carbon Steel	Carbon steel A216-WCB casting
Stainless Steel	Stainless steel A351-CF8M casting
Chrome-moly	Standard – stainless steel A351-CF8M casting; option – Chrome-moly forging equivalent to body material
Alloys	Casting or plate forging equivalent to the body material

EXTENSION MATERIALS

For high or cryogenic temperature applications, standard extensions or cryogenic extensions are used. Extensions are normally manufactured from the same material as the body. Table 12-VIII describes the standard extension material for a given body material:

EXTENSION TYPES

Standard Extension

The standard extension protects the packing and actuator soft goods from excessive heat or cold which may inhibit packing or actuator performance. It is constructed from carbon steel for temperatures from -20 to 800 degrees Fahrenheit, and from 304 or 316 stainless steel for temperatures from -425 to 1500 degrees Fahrenheit. For continuous cryogenic applications, a cryogenic extended bonnet should be used.

Cryogenic Extension

The cryogenic extension permits stagnant, moderate temperature gas to form in the bonnet, which acts as an insulator to minimize heat transfer. This design also protects the packing from the extremely low temperature of the service fluid. It is usually manufactured from 304 or 316 stainless steel and handles temperatures down to -423 degrees Fahrenheit. Unlike the bolt-on design of the standard extension, the cryogenic extension is a welded extension integral with the valve body.

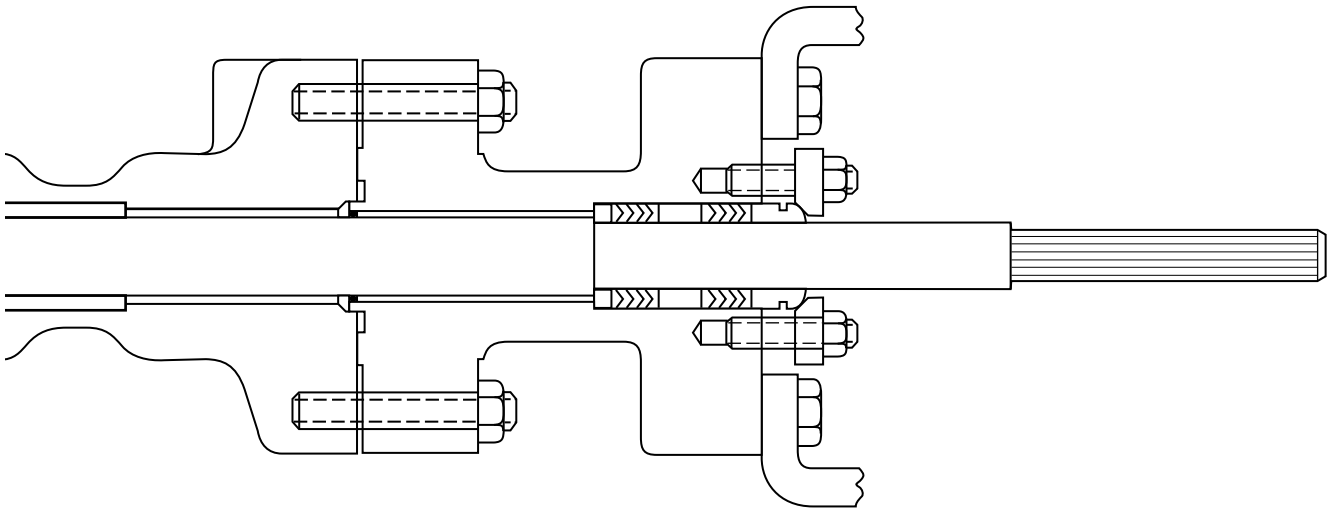


Figure 12-12: Standard Extension

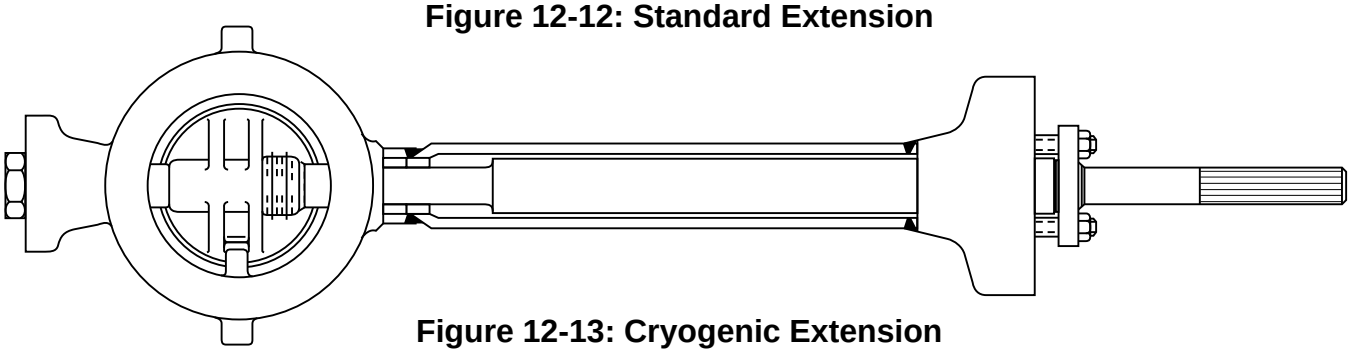


Figure 12-13: Cryogenic Extension

Extension Bolting Material

Table 12-III lists specific temperature limitations and material specifications for standard and extension bolting for ShearStream and Valdisk rotary valves.

PACKING AND PACKING BOX

Standard Valtek packing boxes are designed to permit a wide variety of packing configurations, including twin seal packing. Figure 12-14 shows common Valtek rotary packing box configurations.

Packing configurations can include twin seals where equal amounts of packing are used at both ends of the packing box. This configuration is usually specified when a vacuum seal or lubrication is required. However, twin packing does not improve the sealing capability of the packing, and in some cases may hamper its performance. Lantern rings are provided between the packing sets if stem lubrication is required.

Valtek's standard packing is the Teflon V-ring. This design provides a tight seal at the feather edge of each ring with a minimum amount of stem friction. To achieve a tight seal with Teflon, the packing box bolting is tightened to just over finger-tight. The major limitations of Teflon are its low service temperature limit of approximately 500 degrees Fahrenheit with a standard body and its creep characteristics, which decrease its sealability under load.

Other available packing materials include braided PTFE, glass-filled Teflon, graphite/asbestos-free packing (AFP–Inconel reinforced), and Grafoil. Graphite/AFP, and Grafoil are usually used in high temperature applications.

Table 12-IX shows packing temperature limitations for bodies, standard extensions, and the minimum temperature limitations for packing used with cryogenic extensions. Figures 12-8 shows pressure/temperature curves for Teflon packing in standard and cryogenic extensions. Table 12-8 provides the shaft packing friction forces.

Fugitive Emissions Packing

When special packing is required to keep emissions through packing at a low level, SafeGuard and SureGuard packing sets are used. SafeGuard and SureGuard packing sets are available for new valves or may be retro-fitted into existing Valtek bonnets to provide exceptional leakage control, reliability and longevity. Both systems are available in standard or twin configurations. A fire-safe version is available for rotary valves. See Figure 12-14.

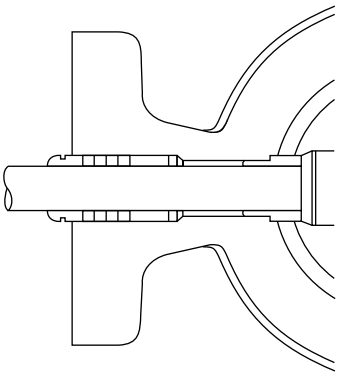
SafeGuard is a Teflon based, V-ring packing set that utilizes the sealing ability of virgin Teflon while minimizing the effects of creep. This is accomplished by backing up the virgin V-rings with carbon-filled Teflon (to prevent extrusion and cold flow) and live loading the entire set to compensate for any Teflon creep due to thermal gradients or wear. Figures 12-8 and 12-9 illustrate the pressure/temperature curve for SafeGuard.

SureGuard is a Kalrez based, V-ring packing set that utilizes the exceptional sealing ability of a perfluorelastomer while maintaining the inertness equivalent of Teflon. Like SafeGuard, the sealing rings are backed up by carbon-filled Teflon to prevent extrusion and increase the life of the packing set. SureGuard XT is a similar packing set with PEEK backup rings, which has the capability to endure temperatures up to 550 degrees Fahrenheit in a standard rotary valve, and up to 700 degrees Fahrenheit with an extension. Figures 12-8 and 12-9 illustrate the pressure/temperature curve for SureGuard and SureGuard XT.

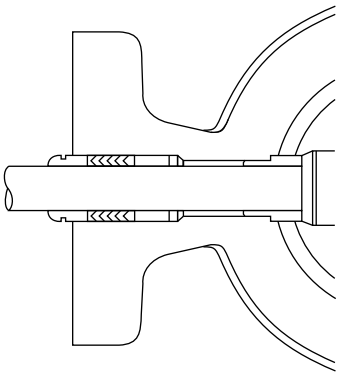
Table 12-IX: Rotary Packing Temperature Limitations, Standard Extensions

Packing Material/Type	Standard Body (1) (degrees F*)	with Extension (1) (degrees F)	with 20-inch Cryongenic Extension	Pressure Limits
Teflon TFE	-20 to 450	-150(2) to 600	-423	Figure 12-8
Braided PTFE (3) Glass-filled Teflon	-20 to 500			
Asbestos-free packing AFPI (5)	-20 to 750 (4)	-20 to 1200	N/A	Body rating
Grafoil (6)	-20 to 750 (4)	-20 to 1500	N/A	Body rating
SafeGuard	-20 to 450	-20 to 600	-423	Figures 12-8, 9
SureGuard	-20 to 450	-20 to 600	-423	Figures 12-8, 9
SureGuard XT	-20 to 550	-20 to 700	-423	Figures 12-8, 9

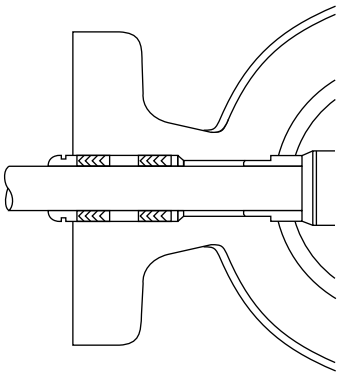
(1) ANSI B16.34 specifies acceptable pressure/temperature limits for pressure retaining materials. Consult factory for additional information.
(2) If the appropriate body and bonnet materials are used.
(3) PTFE is rated to -423 degrees Fahrenheit.
(4) 8 to 12-inch, Class 150 - 600; and 3 to 12-inch, Class 900 - 2500 can be used to 850 degrees Fahrenheit.
(5) Asbestos-free, high temperature packing.
(6) Do not use Grafoil above 800 degrees Fahrenheit in oxidizing service such as air or oxygen.
* Fluid temperatures; see Figures 12-8 thru 12-9.



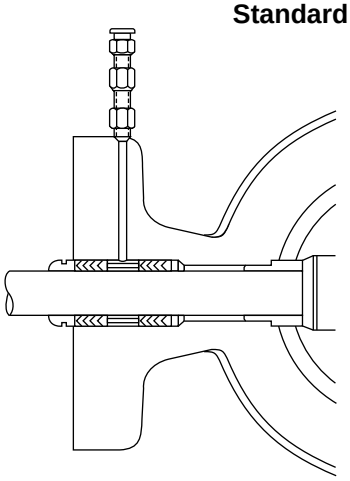
Standard Square



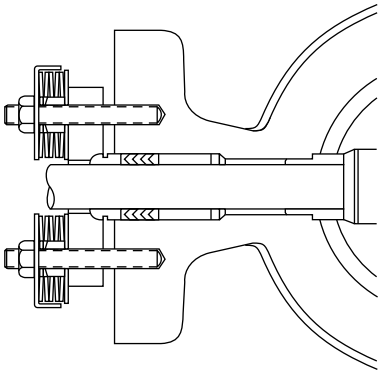
Standard Single "V"



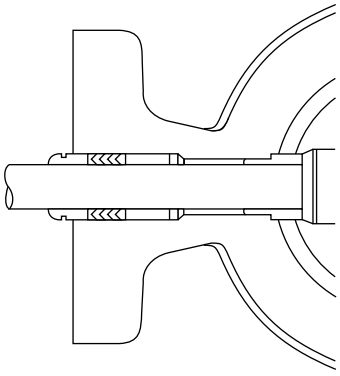
Twin "V"



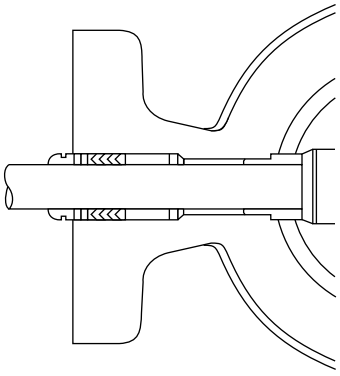
Twin "V" with Lubricator



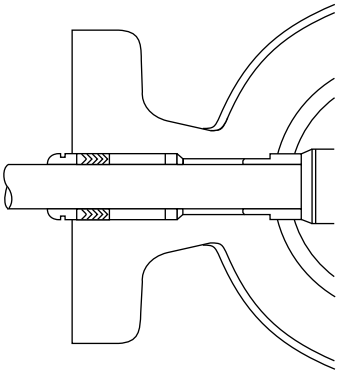
SafeGuard
(packing studs rotated 45 degrees)



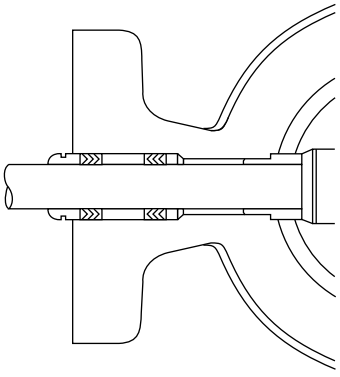
SureGuard



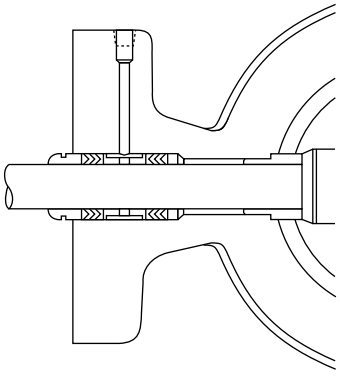
SafeGuard / SureGuard
Fire-safe Option
(live-loading omitted)



Vacuum Single "V"



Vacuum Twin "V"



VacuumTwin "V"
with Purge

Figure 12-14: Typical Rotary Valve Packing Configurations

Table 12-X: Typical Rotary Valve, Stem Packing Friction Forces*

NOTE: *All numbers are in inch-pounds*

Shaft Diameter* (inches)	Teflon Single V	Teflon Twin V	Glass and Carbon-filled Teflon	Grafoil	Braided PTFE	SafeGuard SureGuard Single V	SafeGuard SureGuard Twin V	SafeGuard SureGuard Fire safe
0.5	30	38	43	228	57	29	43	62
0.625	37	46	50	281	63	33	48	68
.75	44	53	57	333	71	38	54	75
1	58	68	71	438	92	48	66	89
1.12	65	75	79	489	104	53	72	97
1.50	86	98	104	648	151	70	82	122

*Packing friction force is a small factor in determining actuator size. Refer to Section 16 to determine correct actuator size for application.
Note: See Table 12-XI for shaft size versus valve size.

Table 12-XI: Shaft Diameter at Packing for Rotary Valve Sizes

Valve Size (inches)	Shaft Diameter	
	Valdisk (inches)	ShearStream (inches)
1	–	.50
$1^1/_2$	–	.625
2	.625	.625
3	.625	.750
4	.750	.750
6	.875	1.0
8	1.125	1.0
10	1.125	1.50
12	1.50	1.50

Note: Contact factory for Valdisk sizes over 12 inches.