FLOWSERVE

TECHNICAL BULLETIN

Standard and Environmental Packing Systems

for Valtek Linear Control Valves

FCD VLENTB0040-01-AQ (04/15)

Experience in Motion

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Packing Selection Guidelines for Valtek® Linear Control Valves

Introduction

This brochure provides information for selecting and specifying packing systems for linear control valve applications. Packings are classified as either environmental or non-environmental. Of these two, environmental packing systems are the more effective and reliable in linear applications where leakage levels are required to be less than 500 parts per million (ppm) or in some cases, less than 100 ppm.

Each of the packing systems shown in this brochure has various available options that can assist in meeting specific customer valve requirements. In each packing system the standard configuration is shown on the left side of each section view, while its various options are shown on the right side. In addition, pressure and temperature envelopes for standard and extended bonnets will aid in the selection of the packing configuration for a given application. Finally, installation and maintenance information will assist in achieving and sustaining the lowest leakage levels possible.

Valve Designs to Enhance Packing Performance

For many years, Flowserve has recognized that a fine finish on the Valtek Mark Series valve stem improves sealing ability and packing life, while reducing packing friction. To maintain these characteristics, the valve stem must remain concentric with the bonnet bore. This is accomplished through the use of double top stem guiding. The stem guiding on both sides of the packing set keeps the packing uniformly compressed, thus preventing leakage and uneven wear. Additionally, larger stem diameters reduce the risk of stem deflections that can cause packing leaks under high actuator loads or pressure drops.

All Valtek linear globe valves feature deep bonnet packing bores. This allows a lower packing set to be placed at least a stroke length below the upper packing set, thus providing protection from foreign particle damage and caking on the stem . Every packing set is also protected from extrusion through the use of close-tolerance, anti-extrusion rings. These rings, packing spacers and stem guides, typically made of 316 stainless steel, are also available in various alloys. Most packing sets come with or have the option to use live loading. Live loading provides a near constant load in applications where high thermal or pressure gradients occur or high stroke cycles are expected.

Packing System Leakage Levels

Environmental packing systems are designed to provide less than 500 ppm service for typical control valve applications. In most services, however, less than 100 ppm can be expected when the packing is specified, installed and maintained correctly. These packings generally have more restrictive application envelopes than non-environmental packings. They can often be used, however, beyond their environmental limits when higher leakage rates can be tolerated. The pressure and temperature limitations for these packings are based upon years of extensive testing and field applications. Many of these packing systems have been tested and certified, meeting such standards as ISO 15848-1, FCI 91-1 and TA-Luft.

While non-environmental packing systems also provide good leakage control, their more simple materials and designs will usually leak at higher levels and will not maintain sustained ultra-low leakage. Nevertheless, for most services that are not volatile organic compounds (VOC), they provide reliable shutoff for extended periods.

For applications requiring zero valve stem leakage, Flowserve offers the Valtek K-Bellows™, a time-tested formed bellows system.

Figure 1: Valtek Mark One™ Control Valve

Environmental Packing Systems

Flowserve offers the following four standard environmental packing systems for linear Valtek control valves. Other proven environmental packing options may be available on request.

1. SafeGuard™
2. SureGuard XT™
3. LATTYpack Control - EC™
4. Chesterton 5800®

Each of these packing systems is capable of achieving very low leakage control for extended periods in their standard or optional configurations. Table 1 provides information to assist the user in selecting the best packing system for the application in question. This selection can be made by considering the fluid, pressure, temperature, required options, sealing performance and stem friction. For more packing system detail, see pages 6 through 13.

Non-Environmental Packing Systems

Flowserve offers the following three non-environmental packing systems for linear Valtek control valves:

1. Standard V-ring
2. Graphite rib-braid
3. Square braid

Within the V-ring and braided packing systems, there are multiple types and choices to best suit various applications, as shown in Table 1. For more packing system detail, see pages 12 through 17.

Table 1: Environmental and Non-Environmental Packing —— Selection Guidelines

	Packing System	Packing Description	Maximum Pressure[4]		Temperature Range[1]				Options Availability	Certification Availability	Relative Sealing Performance	Relative Friction Level
					Standard Bonnets		Extended Bonnets					
			psi	bar	F	C	F	C				
Environmental Packing	SafeGuard (Always live loaded)	Combination of virgin and carbon-filled PTFE V-rings	3000	207	-60 to 450	-51 to 232	-150 to 650	-101 to 343	Standard Twin/ Purge Std. Fire-safe Twin Firesafe Vacuum	Yes	Very Good (less than 500 ppm)	Low
	SureGuard XT	Combination of perfluoreoelastomer and Vespel® V-Rings	4000	276	-20 to 550	-29 to 288	-100 to 750	-73 to 399	Standard Twin/ Purge Std. Fire-safe Twin Firesafe Vacuum Live Loading	Yes	Excellent (less than 100 ppm)	Low
	LATTYpack Control-EC	Combination of Latty 3265flon LM and Lattygraf 6995 NG braided rings	4000	276	-50 to 500	-46 to 260	-150 to 700	-101 to 371	Standard twin purge live loading	Yes	Excellent (less than 100 ppm)	Medium
	Chesterton 5800[2]	Combination of braided carbon and die-formed graphite wedge rings	2000	138	-20 to 1000	-29 to 538	-100 to 1300	-73 to 704	Standard twin purge live loading drive[3]	Yes	Very Good (less than 500 ppm)	High
Non-Environmental Packing	Standard V- Ring	Virgin PTFE V-rings	4000	276	-100 to 400	-73 to 204	-200 to 600	-129 to 316	Standard twin purge vacuum	No	Good	Low
		Filled PTFE V-rings	4500	310	-100 to 500	-73 to 260	-200 to 700	-129 to 371	Standard twin purge vacuum	No	Satisfac-tory	Low
	Square Braided	Square braided PTFE	4500	310	-100 to 500	-73 to 260	-200 to 700	-129 to 371	Standard twin purge live loading	No	Good	Medium
		Square braided carbon fibers (AFPI)	1500	103	-60 to 800	-51 to 427	-160 to 1100	-29 to 593	Standard twin purge live loading	No	Satisfac-tory	Medium
		Square braided graphite strands encapsulated by wire mesh	3500	238	-60 to 1200	-51 to 593	-160 to 1400	-107 to 760	Standard twin purge live loading dry	No	Good	High
	Graphite Rib/ Braid[2]	Combination of braided carbon rings and die-formed graphite square rings	4000	276	-60 to 1000	-53 to 537	-160 to 1300	-107 to 704	Standard twin purge live loading dry[3]	No	Good	High

1. Temperatures limits apply to valve body service temperature for fugitive emission performance (less than 500 ppm). Exceeding these limits may increase leakage and decrease service life.
2. The temperature of graphite packing should not exceed 427°C (800°F) in an oxidizing service such as air.
3. "Dry" graphite packing is void of binders and fillers.
4. Refer to pressure temperature graphs to see how maximum pressure may change with temperature. Consult factory for applications that exceed the pressure temperature envelopes.

Environmental Packing Systems —- SafeGuard

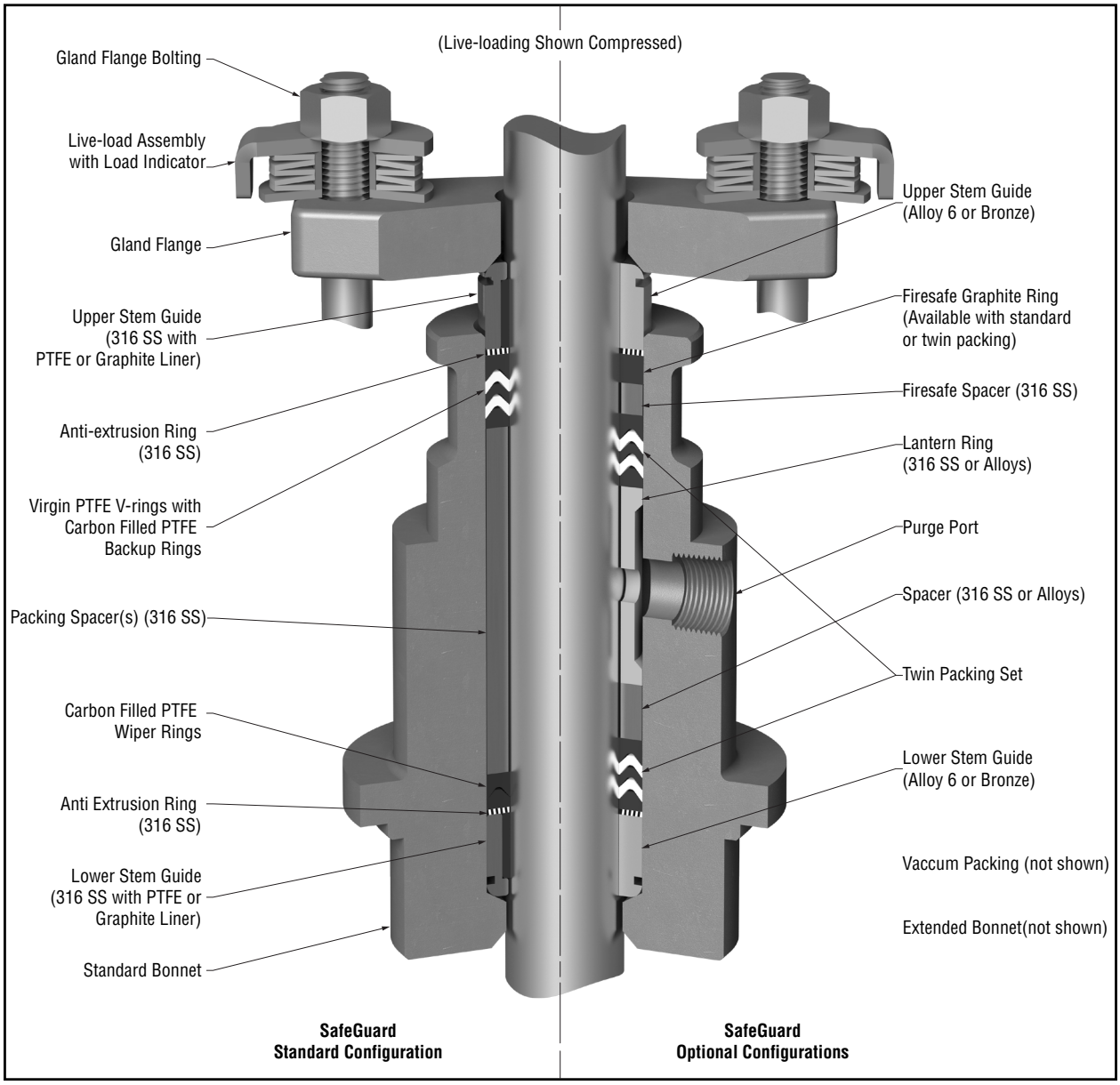

Figure 2 – SafeGuard Standard and Optional Packing Configurations

The SafeGuard packing system consists of a live-loaded, virgin and carbon-filled PTFE V-ring packing set. This packing set is designed to reduce the adverse effects of cold flow consolidation while utilizing the excellent sealing and low-friction characteristics of PTFE. The packing set is always live-loaded to compensate for PTFE cold flow. The live-load kit has an external load indicator to visually ensure a proper packing load and provide simplified maintenance. Due to the chemical inertness of PTFE, SafeGuard can be used in a variety of processes, including those with very low temperature conditions.

SafeGuard is also a more economical fugitive emission solution than Sureguard XT, which is described on page 8. A proven fire-safe option is available which, in the event of a fire, will provide a seal, even if the primary packing set has been rendered useless by excessive heat. A twin packing set is also available with or without the fire-safe option. Although not shown in Figure 2, vacuum packing and extended bonnets are available.

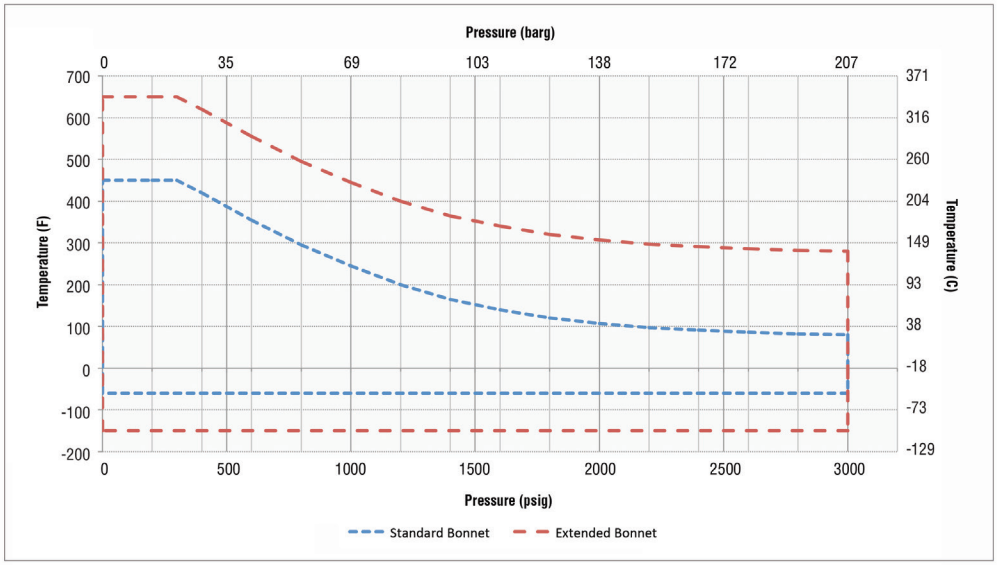

Figure 3: SafeGuard Pressure and Temperature Guidelines — Standard and Extended Bonnet

SafeGuard Packing Installation and Maintenance

Assemble the packing box and the live loading as shown in Figure 2 in accordance with the following:

1. Both packing sets should be placed over the plug stem as a set and not as individual rings.
2. The lowest disc spring ID should contact the lower thrust washer. The remaining four disc springs should be stacked on this disc spring in series as shown.
3. Position the upper thrust washer indicator tab pointing down and oriented opposite of the plug stem.
4. Tighten the gland flange nuts no more than one turn at a time in an alternating manner until the indicator tab on the upper thrust washer is flush with the bottom of the lower thrust washer.
5. Cycle the stem 10 times and re-tighten as needed.
6. Positioning the indicator tab correctly will likely take less torque than found in Table 2. After the valve has been in service and additional torque is needed for leakage control, the torque values in Table 2 may be referenced.
7. If the lower thrust washer travels down below the end of the indicating arm due to packing consolidation and wear, the gland flange nuts should be re-tightened to ensure sufficient loading for the packing (see step 4).
8. If fire-safe packing is used, apply a torque value that is 20% higher than those shown in Table 2.

Table 2: SafeGuard Packing Torque Values

Valve Stem Diameter		Gland Flange Bolt Diameter		Torque Value	
(in)	(mm)	(in)	(mm)	(in-lb)	(Nm)
0.56	14.3	0.38	9.5	24	2.7
		0.50	12.7	32	3.6
0.88	22.2	0.38	9.5	28	3.2
		0.50	12.7	37	4.2
1.12	28.6	0.50	12.7	64	7.2
		0.62	15.9	80	9.0
1.50	38.1	0.50	12.7	78	8.8
		0.62	15.9	102	11.5
		0.75	19.1	123	13.9
2.00	50.8	0.50	12.7	105	11.9
		0.62	15.9	131	14.8
		0.75	19.1	158	17.9
2.50	63.5	0.62	15.9	161	18.2
		0.75	19.1	193	21.8
3.00	76.2	0.62	15.9	296	33.4
		0.75	19.1	356	40.2

Environmental Packing Systems — SureGuard XT

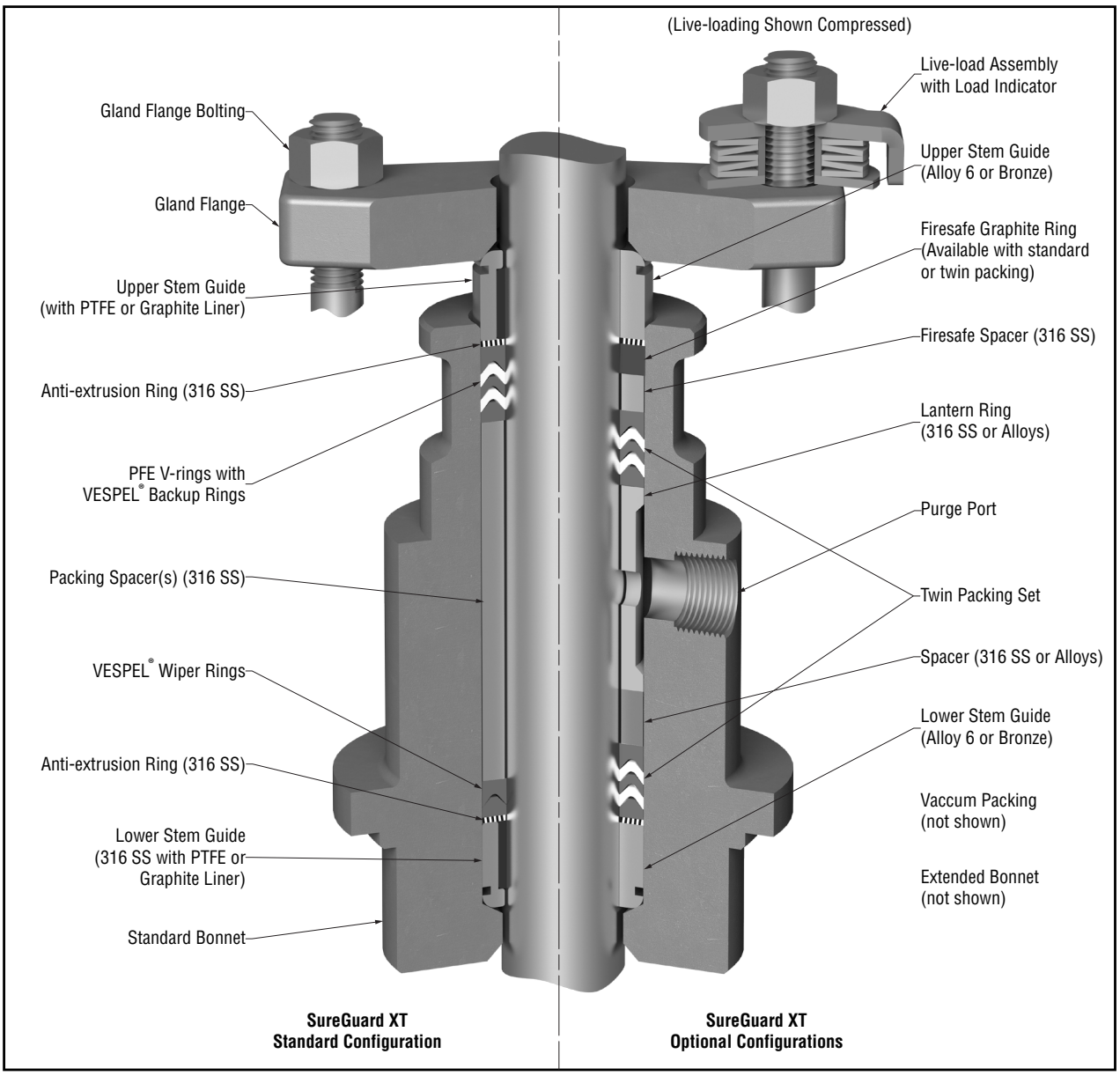

Figure 4: SureGuard XT Standard and Optional Packing Configurations

The SureGuard XT packing system is a V-ring style packing set consisting of perfluoroelastomer (PFE) sealing rings and Vespel CR6100® backup rings. This packing utilizes the resiliency of an elastomer and backup rings to maintain a tight, durable seal that will not easily cold flow or extrude under pressure. Since elastomers under compression are inherently live-loaded, external live-loading is not required. Live-loading, however, is beneficial in reducing maintenance in applications with high thermal or pressure gradients. Since PFE is nearly as chemically inert as PTFE, it can be used in many similar applications.

This packing system is very reliable and, when installed and maintained correctly, will keep emissions below 100 ppm. Certified testing has shown that SureGuard XT easily meets the ISO 15848-1 Class B and the FCI 91-1 Class B1 leakage levels (less than 100 ppm).

A fire-safe option is available which, in the event of a fire, will provide a seal, even if the primary packing set has been rendered useless by excessive heat. A twin packing set is also available with or without the fire-safe option. Although not shown in Figure 4, vacuum packing and extended bonnets are available. SureGuard XT is available with Greene Tweed Chemraz® sealing rings or optionally with DuPont Kalrez®.

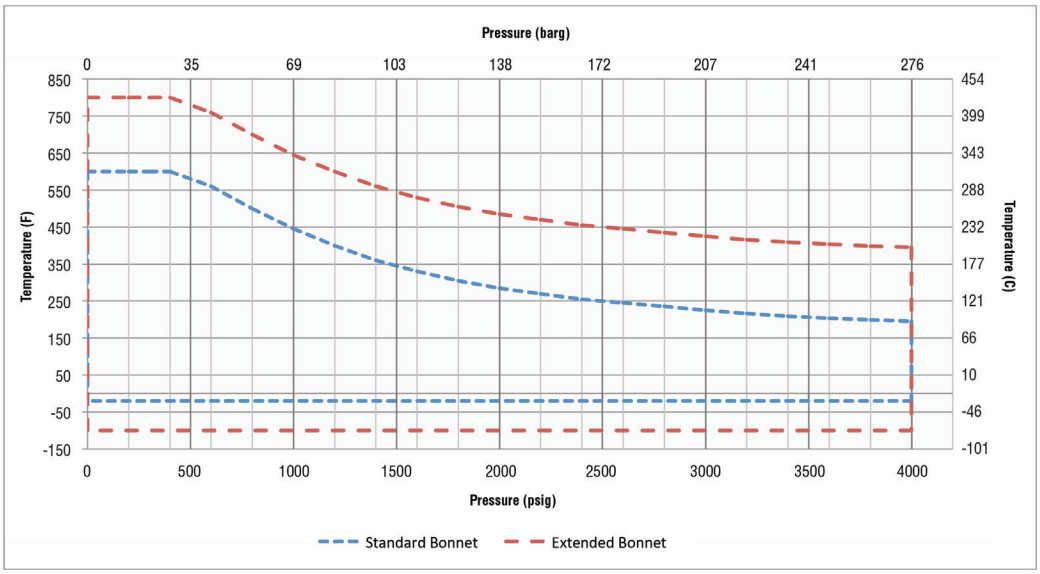

Figure 5: SureGuard XT Pressure and Temperature Guidelines — Standard and Extended Bonnet

SureGuard XT Packing Installation and Maintenance

Assemble the packing box as shown in Figure 4 in accordance with the following:

1. Prior to assembling the upper packing set, apply a small bead of a fluorinated grease around the center of the concave side of each V-ring and female adapter. (Flowserve recommends using DuPont Krytox 206® grease.)
2. Both packing sets should be placed over the plug stem as a set and not as individual rings.
3. If live-loading is required, follow the assembly instructions for SafeGuard live-loading on page 6.
4. Measure the valve stem and the gland flange bolt diameters. Compress the packing to the torque value shown in Table 3.
5. Compress the packing set with alternate compressions between the gland flange bolts in approximate increments of 25% of the torque value until the desired torque value is reached (four compressions). If live-loading is to be used, follow the instructions given on page 6.
6. If fire-safe packing is used, apply a torque value that is 20% higher than the values shown in Table 3.

Table 3: SureGuard XT Packing Torque Values

Valve Stem Diameter		Gland Flange Bolt Diameter		Torque Value	
(in)	(mm)	(in)	(mm)	(in-lb)	(Nm)
0.56	14.3	0.38	9.5	26	3.0
		0.50	12.7	35	4.0
0.88	22.2	0.38	9.5	31	3.5
		0.50	12.7	41	4.6
1.12	28.6	0.50	12.7	70	8.0
		0.62	15.9	88	9.9
1.50	38.1	0.50	12.7	86	9.7
		0.62	15.9	112	12.7
		0.75	19.1	135	15.3
2.00	50.8	0.50	12.7	116	13.1
		0.62	15.9	144	16.3
		0.75	19.1	174	19.6
2.50	63.5	0.62	15.9	177	20.0
		0.75	19.1	212	24.0
3.00	76.2	0.62	15.9	326	36.8
		0.75	19.1	392	44.3

Environmental Packing Systems — LATTYpack Control - EC™

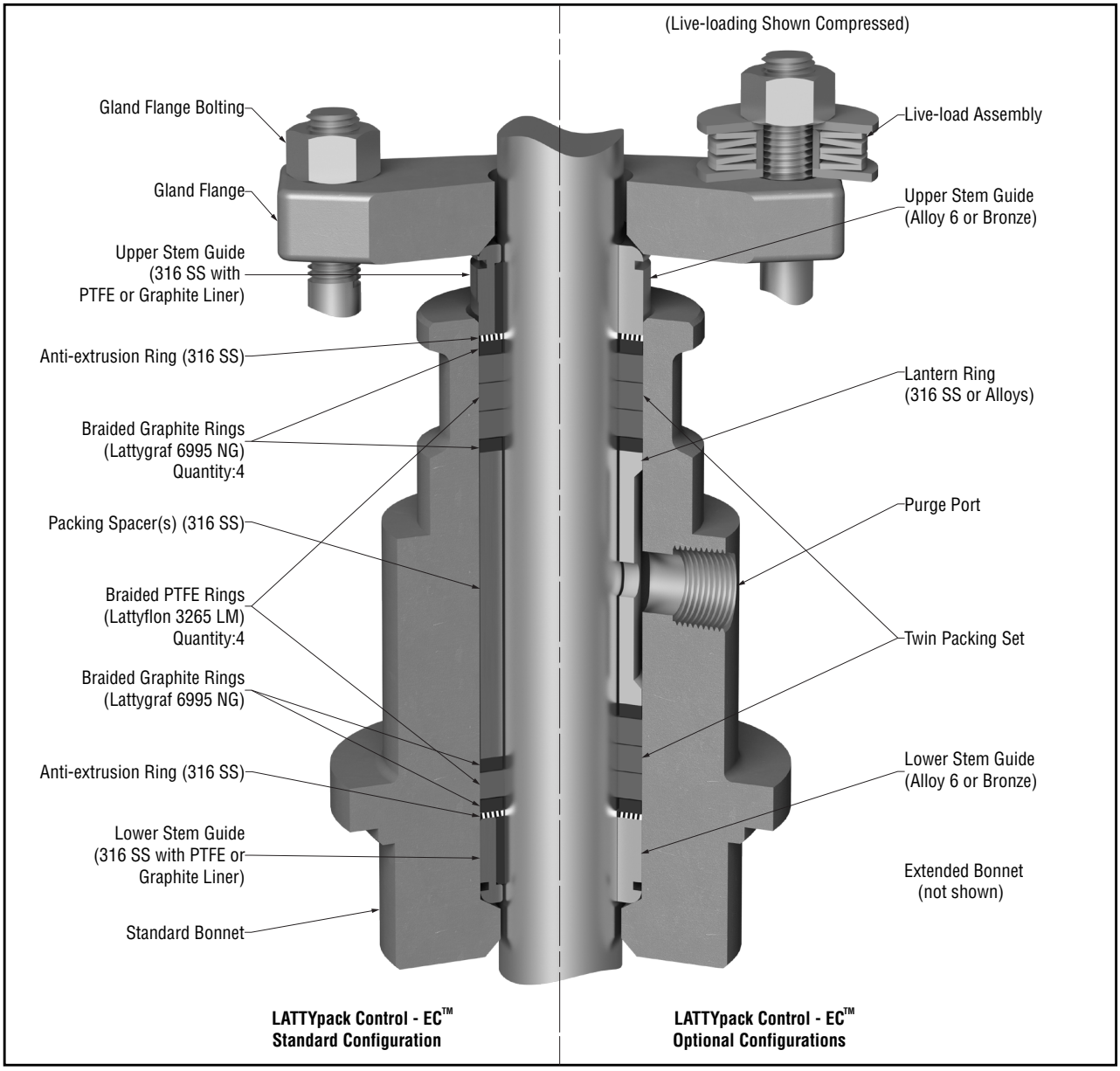

Figure 6: LATTYpack Control - EC™ Standard and Optional Packing Configurations

The LATTYpack Control-EC packing set as shown in Figure 6 utilizes a two-stage sealing system to obtain very low emission rates in many types of services. The LATTYflon 3265 LM® sealing rings are made of plaited, PTFE coated, carbon yarn core that is covered with a braided, PTFE yarn jacket. The LATTYgraf 6995 NG® wiper rings are constructed from pure, expanded graphite yarns that are encapsulated with a fine Inconel® wire mesh and then braided and die-formed to provide excellent wiping action and extrusion resistance.

This combination of materials also allows higher temperatures and pressures to be achieved than with a PTFE-based packing set. Certified testing has shown that LATTYpack Control-EC packing in a Mark One control valve complies with the ISO 15848-1 Class A leakage levels. Live-loading is optional with this packing and is recommended in applications experiencing high thermal and pressure gradients. Twin packing arrangements are available as well for purge applications. All applications are available in an extended bonnet.

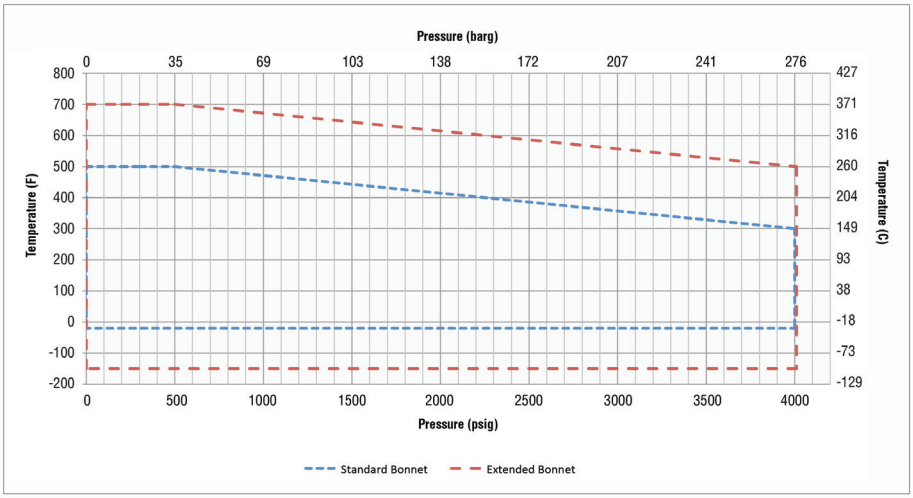

Figure 7: LATTYpack Control - EC™ Pressure and Temperature Guidelines — Standard and Extended Bonnet

LATTYpack Control - EC™ Packing Installation and Maintenance

Assemble the packing box as shown in Figure 6 in accordance with the following:

1. If twin packing is used, the lower packing should be tightened independent of the upper packing by tamping or with gland flange compression. If live-loading is provided, assemble per the factory-provided drawing.
2. Measure the valve stem and the gland flange bolt diameters. Compress the packing to the lower end of the torque range shown in Table 4.
3. Alternate compressions between the gland flange bolts in approximate increments of 25% of the lower torque value until the desired torque value is reached (compressions).
4. Stroke the valve 10 times and re-tighten each bolt to the desired torque value after the last down stroke.
5. *The following must **only** be done according to plant policy and safety protocol.* After valve is in service and at temperature, re-tighten the packing bolts to the desired torque value. If the valve starts to leak in service, re-tighten to the recommended torque value. If leaking persists, tighten the packing toward the maximum torque value shown in Table 4.

Table 4: LATTYpack Control - EC™ Packing Torque Values

Valve Stem Diameter		Gland Flange Bolt Diameter		Pressure Class					
				150/900		1500		2500	
				Torque					
(in)	(mm)	(in)	(mm)	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm
0.56	14.3	0.38	9.5	6-7	8-10	10-12	14-17	12-14	16-19
		0.50	12.7	8-10	11-13	13-16	18-22	15-19	21-25
0.88	22.2	0.38	9.5	7-9	9-12	12-14	16-19	13-16	18-22
		0.50	12.7	9-11	12-15	15-19	21-25	16-22	25-30
1.12	28.6	0.50	12.7	15-19	21-25	26-32	36-44	31-38	42-52
		0.62	15.9	19-23	26-32	33-40	45-55	38-47	52-63
1.50	38.1	0.50	12.7	20-24	26-32	34-41	46-56	39-48	54-65
		0.62	15.9	24-30	33-40	42-51	57-69	49-60	66-81
		0.75	19.1	29-35	39-48	50-61	67-82	58-71	79-96
2.00	50.8	0.50	12.7	26-31	35-42	44-53	59-72	51-62	69-84
		0.62	15.9	31-38	42-52	53-65	72-89	63-77	85-104
		0.75	19.1	37-45	50-62	64-78	66-105	74-91	101-123
2.50	63.5	0.62	15.9	38-47	52-63	66-80	89-109	76-93	103-126
		0.75	19.1	46-56	62-75	78-95	106-129	91-111	123-151
3.00	76.2	0.62	15.9	71-86	96-117	121-148	164-200	141-173	192-234
		0.75	19.1	84-103	114-139	144-176	195-239	168-205	227-278

Environmental Packing Systems — Chesterton 5800

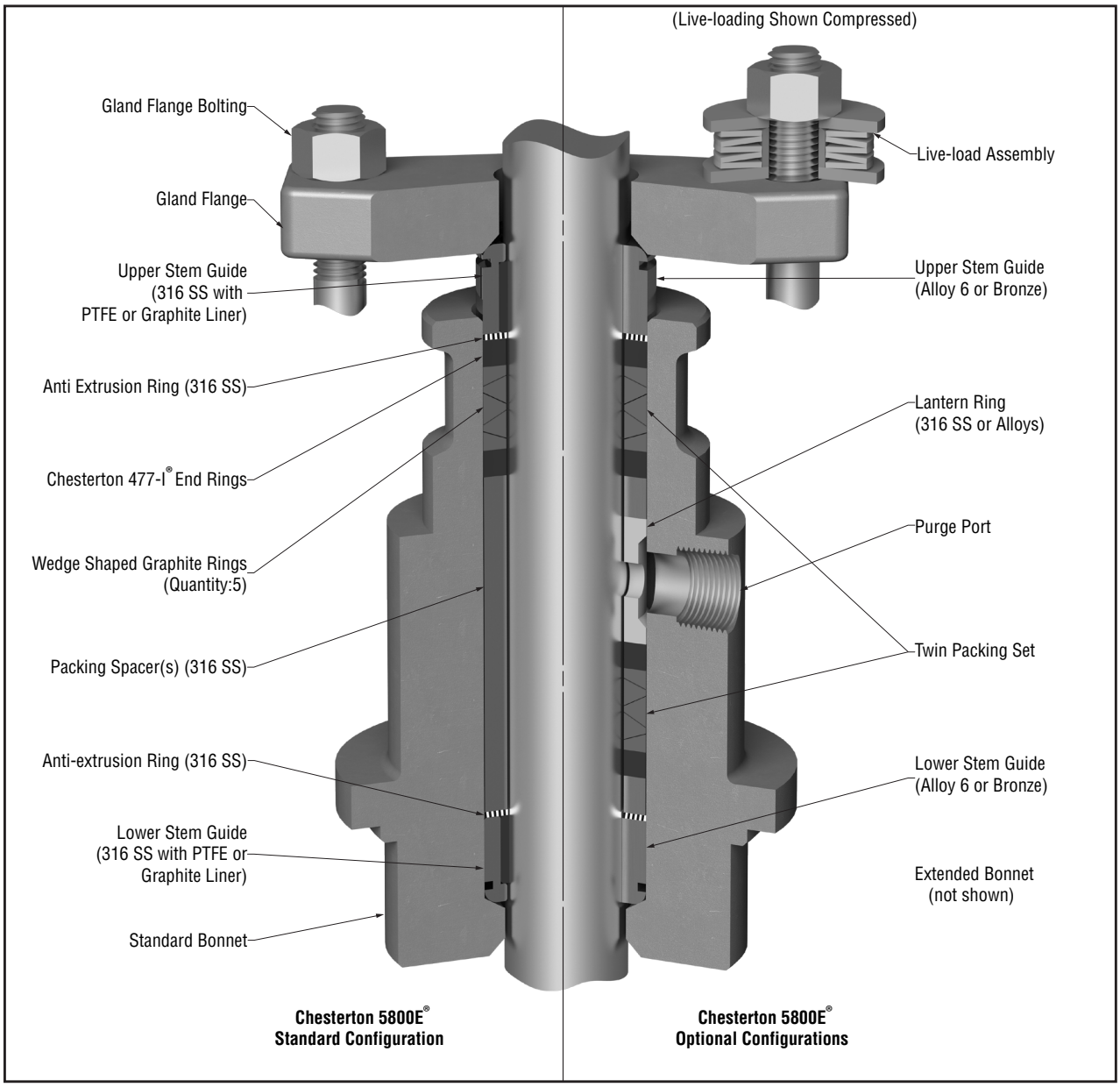

Figure 8: Chesterton 5800® Standard and Optional Packing Configurations

The Chesterton 5800E® packing system consists of die-formed, wedge-shaped rings contained by Chesterton 477-I® braided end rings, as shown in Figure 8. The sealing rings in this packing set are made of high-density graphite formed at mating angles to allow for greater radial packing movement when axial gland loads are applied. This results in an excellent stem seal with less friction than traditional square graphite packing sets. The end rings are of carbon fiber braided construction reinforced with Inconel wire.

Certified testing has shown that Chesterton 5800E meets ISO 15848-1 Class B leakage levels in Mark One control valves. They provide stem wiping action as well as extrusion protection. Live-loading is optional with this packing and is recommended in applications experiencing thermal and pressure gradients. Twin packing is also available as well as dry packing, i.e., free of binders and fillers. All options are also available in an extended bonnet.

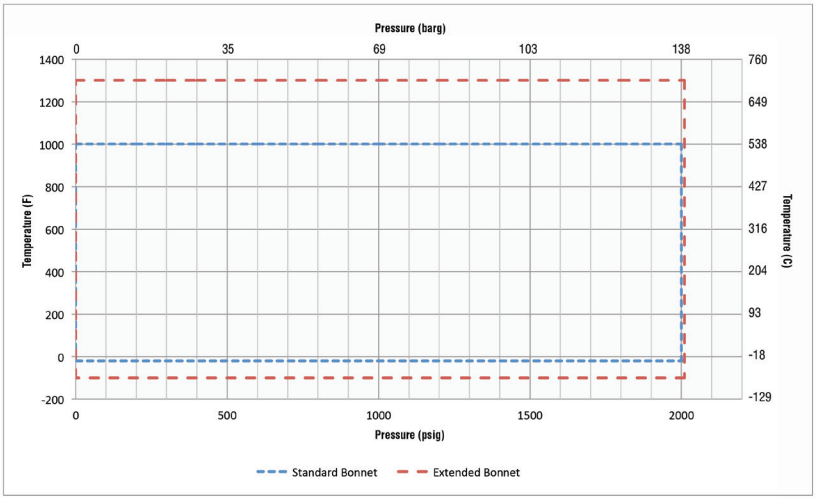

Figure 9: Chesterton 5800 Pressure and Temperature Guidelines — Standard and Extended Bonnet

Chesterton 5800 Packing Installation and Maintenance

Assemble the packing box as shown in Figure 8 in accordance with the following:

1. To decrease friction on Chesterton 5800E packing, the valve stem may be lightly coated with nickel anti-seize lubricant.
2. If twin packing is used, the lower packing should be tightened independent of the upper packing by tamping or gland flange compression. If live-loading is provided, assemble per the factory-provided drawing.
3. Measure the valve stem and the gland flange bolt diameters. Compress the packing to the lower end of the torque range shown in Table 5.
4. Alternate compressions between the gland flange bolts in approximate increments of 25% of the lower torque value until the desired torque value is reached (compressions).
5. Stroke the valve 10 times and re-tighten each bolt to the desired torque value after the last down stroke.
6. *The following must **only** be done according to plant policy and safety protocol.* After the valve is in service and at temperature, re-tighten the packing bolts to the desired torque value. If the valve starts to leak in service, re-tighten to the recommended torque value. If leaking persists, tighten the packing toward the maximum torque value shown in Table 5.

Table 5: Chesterton 5800 Packing Torque Values

Valve Stem Diameter		Gland Flange Bolt Diameter		Pressure Class							
				150/600		900		1500		2500	
				Torque							
(in)	(mm)	(in)	(mm)	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm
0.56	14.3	0.38	9.5	4-5	5-6	6-7	8-9	9-11	13-15	15-19	21-25
		0.50	12.7	5-6	7-8	7-9	10-12	12-15	17-20	21-25	28-34
0.88	22.2	0.38	9.5	4-5	6-7	6-8	9-11	11-13	15-18	18-22	24-30
		0.50	12.7	6-7	8-9	9-10	12-14	14-17	20-24	24-29	33-39
1.12	28.6	0.50	12.7	10-12	13-16	15-18	20-24	25-30	34-41	41-50	59-68
		0.62	15.9	12-15	17-20	19-23	25-31	31-35	42-51	52-63	70-85
1.50	38.1	0.50	12.7	13-15	17-21	19-23	26-31	32-38	43-52	53-64	71-87
		0.62	15.9	16-19	21-26	24-29	32-39	40-48	54-65	66-80	89-108
		0.75	19.1	19-23	26-31	28-34	39-47	47-57	64-78	79-96	107-130
2.00	50.8	0.50	12.7	16-20	22-27	24-30	33-40	41-49	55-67	68-82	92-111
		0.62	15.9	20-25	28-33	30-37	41-50	51-62	69-83	85-103	115-139
		0.75	19.1	24-30	33-40	37-44	50-60	61-74	83-100	102-123	138-167
2.50	63.5	0.62	15.9	25-30	34-41	37-45	51-61	62-75	84-102	104-125	140-170
		0.75	19.1	30-36	40-49	45-54	61-73	75-90	101-122	123-150	168-204
3.00	76.2	0.62	15.9	46-55	62-75	69-83	93-113	114-138	155-188	191-231	258-313
		0.75	19.1	55-66	74-90	82-100	112-135	137-166	186-225	229-277	310-375

Non-Environmental Packing Systems — Standard V-Ring

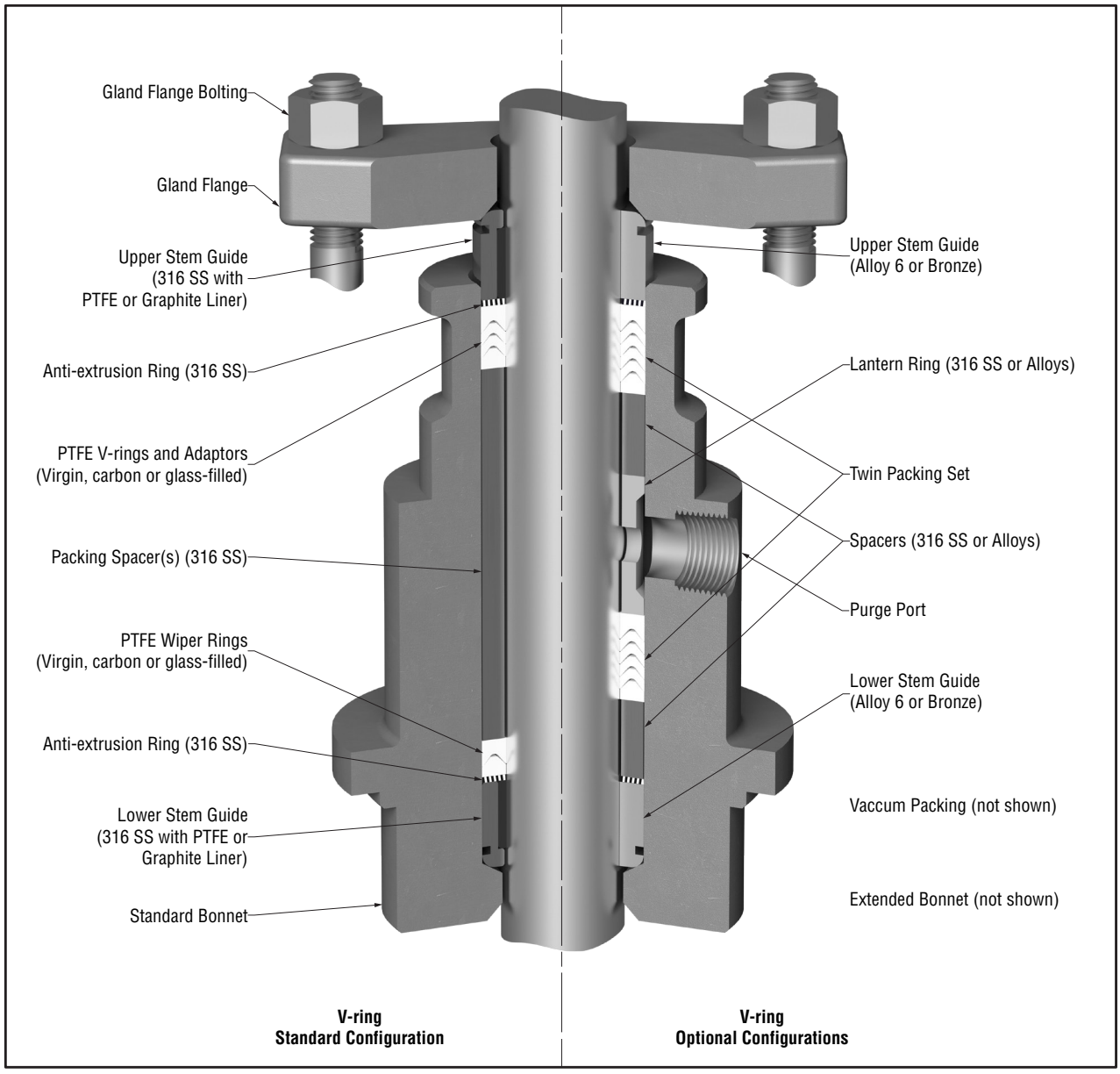

Figure 10: V-Ring Standard and Optional Packing Configurations

The standard V-ring packing system consists of V-rings designed to minimize friction while maintaining good leakage control in a wide range of general and chemical applications. It is available in virgin, glass-filled or carbon-filled PTFE. Filled PTFE packing sets do not seal as effectively as virgin PTFE but will better resist extrusion and cold-flow at higher temperatures and pressures. This packing system is both the most economical and has the lowest friction levels of all Valtek packing systems.

Wiper rings are standard with most linear applications to protect the primary sealing rings. Twin and vacuum packing options are available with this packing set. If live-loading is desired, a Safe-Guard packing set should be used since it has been specifically designed to resist the extrusion inherent with live-loaded PTFE. Although not shown in Figure 10, vacuum packing and extended bonnets are available.

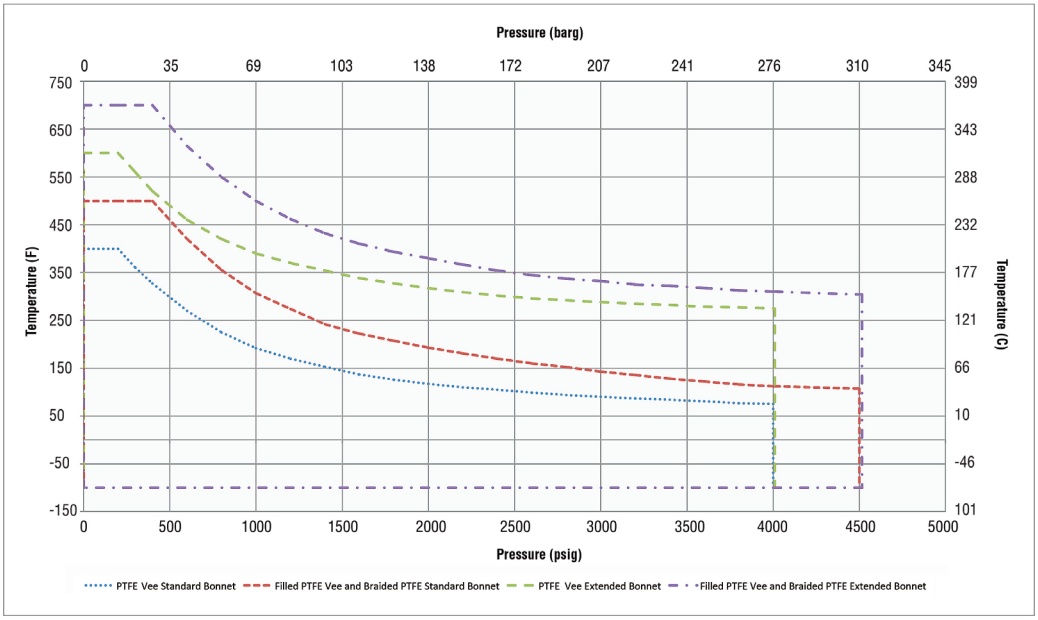

Figure 11: V-Ring Packing Pressure and Temperature Guidelines — Standard and Extended Bonnet

V-Ring Packing Installation and Maintenance

Assemble the packing box as shown in Figure 10 in accordance with the following:

1. Both packing sets should be placed over the plug stem as a set and not as individual rings.
2. Measure the valve stem and the gland flange bolt diameters. Compress the packing to the torque value shown in Table 6.
3. Compress the packing set with alternate compressions between the gland flange bolts in approximate increments of 25% of the torque value until the desired torque value is reached (four compressions).
4. If glass-filled or carbon-filled PTFE packing is used, apply a torque value up to 20% higher than the values shown in Table 6.
5. Stroke the valve 10 times and re-tighten the gland flange bolting to the specified torque value.

Table 6: V-Ring Packing Torque Values

Valve Stem Diameter		Gland Flange Bolt Diameter		Torque Value	
(in)	(mm)	(in)	(mm)	(in-lb)	(Nm)
0.56	14.3	0.38	9.5	14	1.6
		0.50	12.7	19	2.2
0.88	22.2	0.38	9.5	17	1.9
		0.50	12.7	22	2.5
1.12	28.6	0.50	12.7	38	4.3
		0.62	15.9	48	5.4
1.50	38.1	0.50	12.7	47	5.3
		0.62	15.9	61	6.9
		0.75	19.1	74	8.3
2.00	50.8	0.50	12.7	63	7.1
		0.62	15.9	79	8.9
		0.75	19.1	95	10.7
2.50	63.5	0.62	15.9	97	10.9
		0.75	19.1	116	13.1
3.00	76.2	0.62	15.9	178	20.1
		0.75	19.1	214	24.1

Non-Environmental Packing Systems — Graphite Rib-Braid

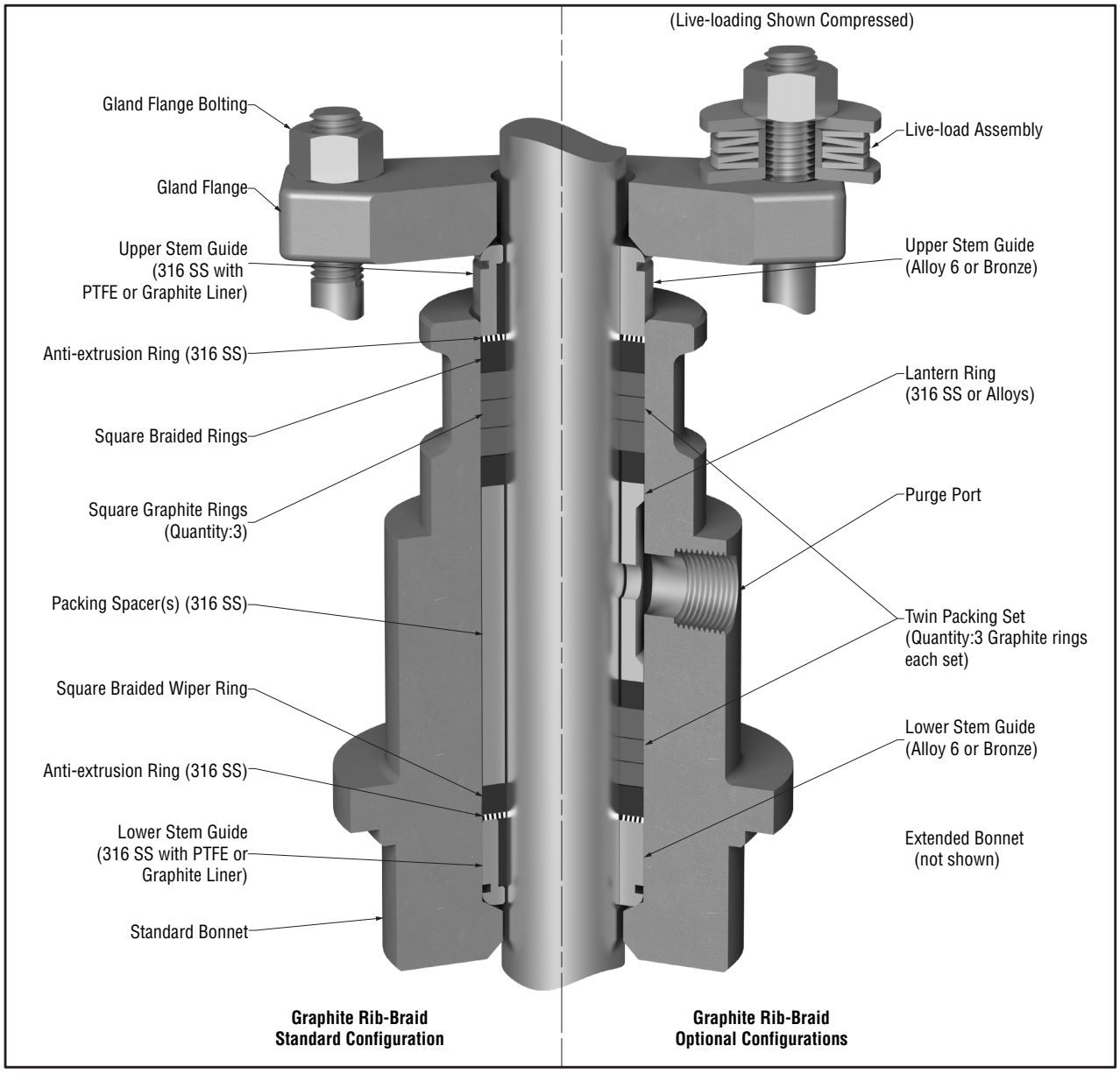

Figure 12: Graphite Rib-Braid Standard and Optional Packing Configurations

The graphite rib-braid packing system consists of high-density, die-formed graphite ribbon sealing rings that are contained within square, carbon braided, end rings. The end rings provide stem wiping action as well as prevent extrusion or migration of the graphite packing. This packing is well suited for high-temperature environments, including applications that require fire safety. This packing provides better sealing than square braided packing rings but has higher friction. This packing may not be well suited for control applications that require very small step response. This packing is available in a twin configuration and with live-loading.

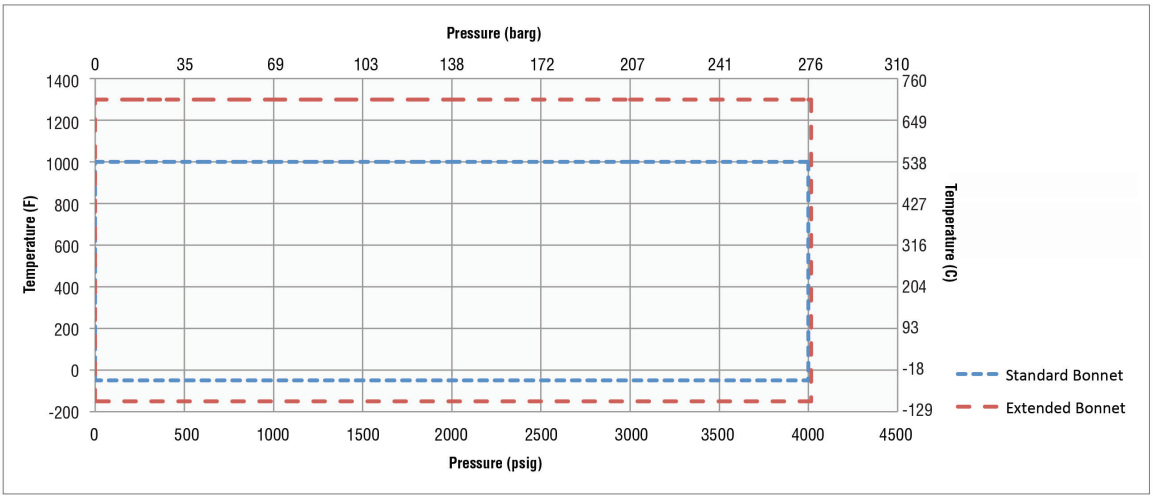

Figure 13: Graphite Rib-Braid Packing Pressure and Temperature Guidelines — Standard and Extended Bonnet

Graphite Rib-Braid Packing Installation and Maintenance

Assemble the packing box as shown in Figure 12 according to the following:

1. If twin packing is used, the lower packing should be tightened independent of the upper packing by tamping or gland flange compression. If live-loading is provided, assemble per the factory-provided drawing.
2. To decrease friction on graphite-rib braid packing, the valve stem may be lightly coated with nickel anti-seize lubricant.
3. Measure the valve stem and the gland flange bolt diameters. Compress the packing to the lower end of the torque range shown in Table 7.
4. Alternate compressions between the gland flange bolts in approximate increments of 25% of the lower torque value until the desired torque value is reached (compressions).
5. Stroke the valve 10 times and re-tighten each bolt to the desired torque value after the last down stroke.
6. *The following must **only** be done according to plant policy and safety protocol.* After the valve is in service and at temperature, re-tighten the packing bolts to the desired torque value. If the valve starts to leak in service, re-tighten to the recommended torque value. If leaking persists, tighten the packing toward the maximum torque value shown in Table 7.

Table 7: Graphite Rib-Braid Packing Torque Values

Valve Stem Diameter		Gland Flange Bolt Diameter		Pressure Class							
				150/600		900		1500		2500	
				Torque							
(in)	(mm)	(in)	(mm)	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm
0.56	14.3	0.38	9.5	4-5	5-6	6-7	8-9	9-11	13-15	15-19	21-25
		0.50	12.7	5-6	7-8	7-9	10-12	12-15	17-20	21-25	28-34
0.88	22.2	0.38	9.5	4-5	6-7	6-8	9-11	11-13	15-18	18-22	24-30
		0.50	12.7	6-7	8-9	9-10	12-14	14-17	20-24	24-29	33-39
1.12	28.6	0.50	12.7	10-12	13-16	15-18	20-24	25-30	34-41	41-50	59-68
		0.62	15.9	12-15	17-20	19-23	25-31	31-35	42-51	52-63	70-85
1.50	38.1	0.50	12.7	13-15	17-21	19-23	26-31	32-38	43-52	53-64	71-87
		0.62	15.9	16-19	21-26	24-29	32-39	40-48	54-65	66-80	89-108
		0.75	19.1	19-23	26-31	28-34	39-47	47-57	64-78	79-96	107-130
2.00	50.8	0.50	12.7	16-20	22-27	24-30	33-40	41-49	55-67	68-82	92-111
		0.62	15.9	20-25	28-33	30-37	41-50	51-62	69-83	85-103	115-139
		0.75	19.1	24-30	33-40	37-44	50-60	61-74	83-100	102-123	138-167
2.50	63.5	0.62	15.9	25-30	34-41	37-45	51-61	62-75	84-102	104-125	140-170
		0.75	19.1	30-36	40-49	45-54	61-73	75-90	101-122	123-150	168-204
3	76.2	0.625	15.9	46-55	62-75	69-83	93-113	114-138	155-188	191-231	258-313
		0.75	19.1	55-66	74-90	82-100	112-135	137-166	186-225	229-277	310-375

Non-Environmental Packing Systems — Square Braided

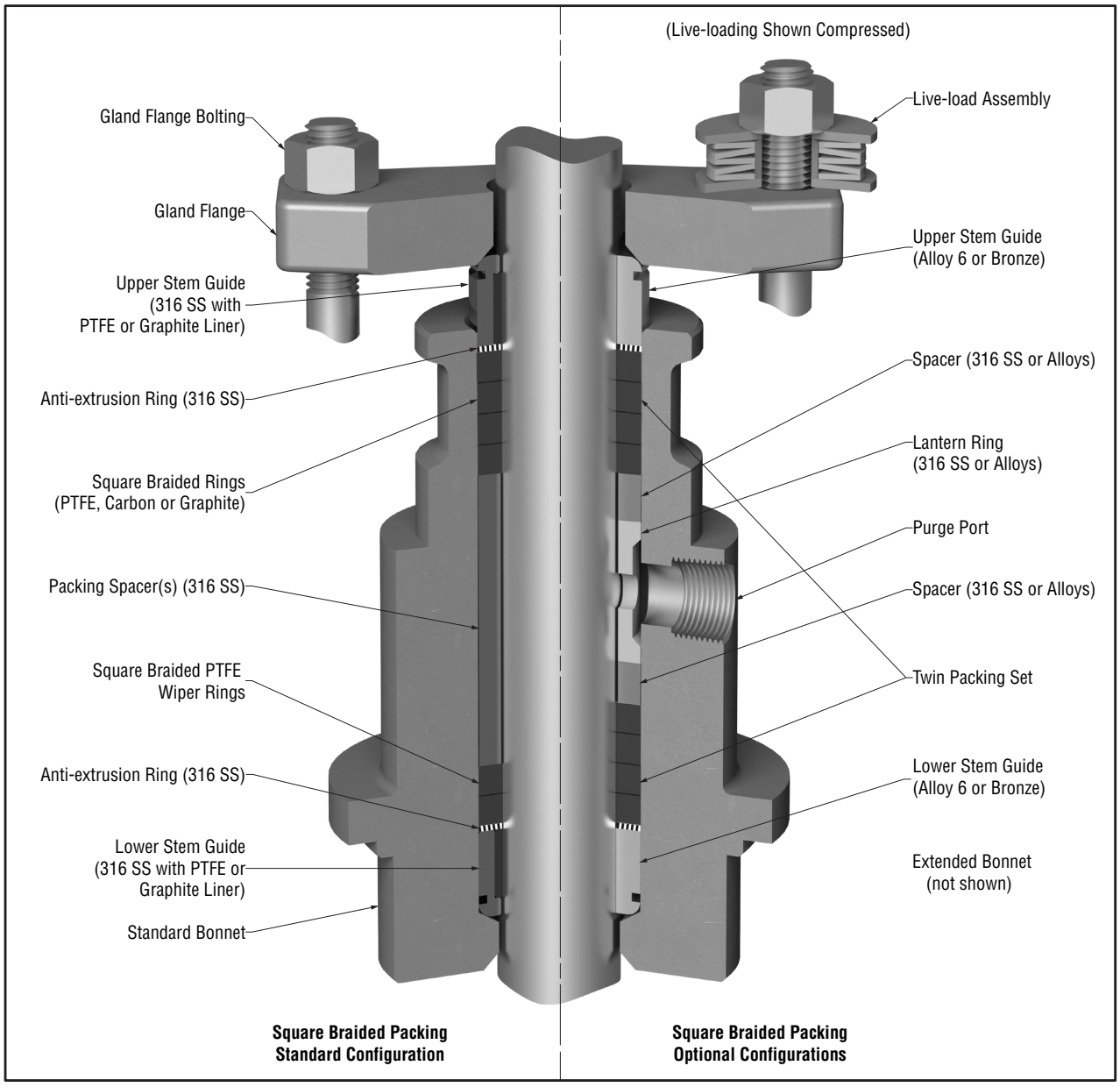

Figure 14: Square-Braided Standard and Optional Packing Configuration

The square-braided packing system utilizes one of three different materials. Each material option uses the same square packing braid throughout the packing box. Square-braided packing is often used for applications that require economical, yet long-life packing. Each of these packing types has a twin packing and a live-loading option. The three material types available are:

Braided PTFE — This packing consists of a high-density, continuous-filament, lattice PTFE braid. It resists extrusion more effectively than any other PTFE-based packing. It is also an excellent choice in many chemical applications or when solids may be present. See Figure 11 for pressure temperature data.

Braided Carbon — This packing consists of a medium-density, lattice carbon braid. It has an internal Inconel wire re-enforcement to resist high-pressure extrusion. Square carbon-braided packing provides the advantages of high-temperature fire safety without the high friction associated with die-formed graphite packing. This packing can come with or without a zinc corrosion inhibitor.

Braided Graphite — This fire-safe packing consists of high-purity flexible graphite strands encapsulated by a fine Inconel filament mesh. These strands are braided and then die-formed into a high-density packing ring. Although the friction level is high, it offers excellent resistance to wire-draw and blowout in high-pressure steam applications. Hardened stems are recommended for optimum leakage control.

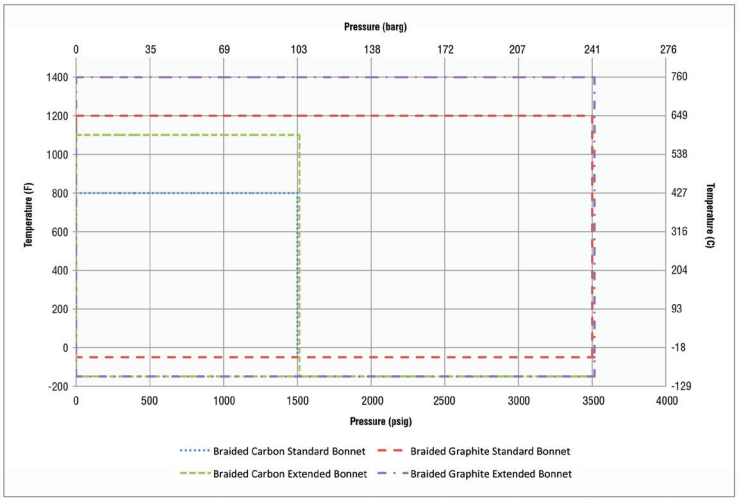

Figure 15: Square-Braided Packing Pressure and Temperature Guidelines — Standard and Extended Bonnet (see Figure 11 or Braided PTFE)

Square-Braid Packing Installation and Maintenance

Assemble the packing box as shown in Figure 14 according to the following:

1. To decrease friction on non-PTFE braided packing, the valve stem may be lightly coated with nickel anti-seize lubricant.
2. Braided packing ring skive-cuts must be properly overlapped with joints of adjacent rings offset 90°.
3. If twin packing is used, the lower packing should be tightened independent of the upper packing. If live-loading is provided, assemble per the factory-provided drawing.
4. Measure the valve stem and the gland flange bolt diameters. Compress the packing to the lower end of the torque range shown in Table 8.
5. Alternate compressions between the gland flange bolts in approximate increments of 25% of the torque value until the desired torque value is reached (compressions).
6. Stroke the valve 10 times and re-tighten each bolt to the desired torque value after the last down stroke.
7. *The following must **only** be done according to plant policy and safety protocol.* After the valve is in service and at temperature, re-tighten the packing bolts to the desired torque value. If the valve starts to leak in service, re-tighten to the recommended torque value. If leaking persists, tighten the packing toward the maximum torque value.

Table 8: Square-Braided Packing Torque Values

Valve Stem Diameter		Gland Flange Bolt Diameter		Pressure Class							
				150/600		900		1500		2500	
				Torque							
(in)	(mm)	(in)	(mm)	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm
0.56	14.3	0.38	9.5	7-8	9-11	8-10	11-14	12-14	16-19	18-21	24-29
		0.50	12.7	8-9	11-13	10-12	14-17	15-18	20-24	22-27	30-37
0.88	22.2	0.38	9.5	7-9	10-12	9-11	13-15	13-16	18-22	20-24	27-33
		0.50	12.7	9-10	12-14	11-14	15-18	17-20	23-27	26-31	35-42
1.12	28.6	0.50	12.7	12-15	17-20	17-21	23-28	26-32	36-43	42-51	57-69
		0.62	15.9	15-18	20-24	21-25	28-34	32-39	44-53	52-62	70-85
1.50	38.1	0.50	12.7	15-18	20-25	21-25	28-34	33-40	44-54	52-64	71-86
		0.62	15.9	18-22	24-29	25-31	34-42	40-49	54-66	65-78	88-106
		0.75	19.1	21-25	28-34	30-36	40-49	48-58	64-78	77-93	105-127
2.00	50.8	0.50	12.7	18-22	25-30	26-31	35-43	41-50	56-68	67-81	90-109
		0.62	15.9	22-27	30-36	32-38	43-52	51-61	69-83	82-100	112-135
		0.75	19.1	26-31	35-43	37-45	51-61	60-73	82-99	98-119	135-161
2.50	63.5	0.62	15.9	26-32	36-43	38-46	52-62	61-74	83-101	100-121	136-164
		0.75	19.1	31-38	42-51	45-54	61-74	73-88	99-120	119-145	162-196
3.00	76.2	0.62	15.9	46-56	62-75	67-82	91-111	110-133	141-181	181-220	246-298
		0.75	19.1	55-66	74-89	80-97	109-132	132-159	178-216	217-263	294-356

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