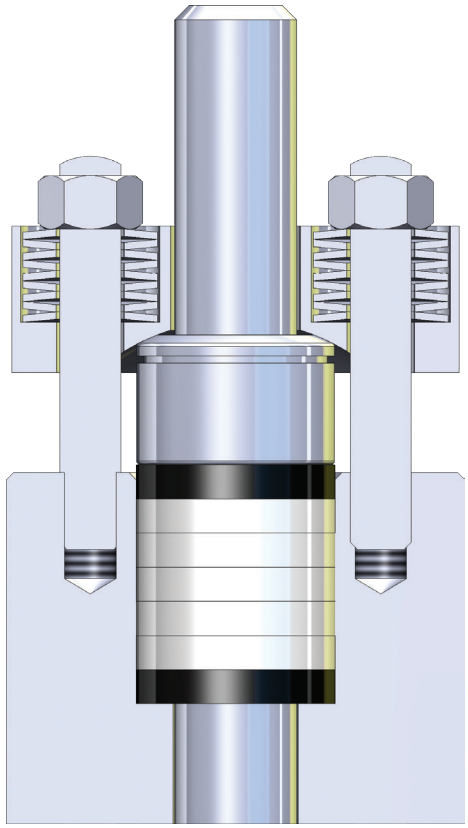
Technical Specifications
Rev. B - 12/2019

Masoneilan™ Low-E Packing Series

Low Emissions Packing

Designed to meet and exceed the most rigorous industrial emission standards and expectations, minimizing control valve fugitive emissions



Baker Hughes

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Features & Benefits

The Masoneilan Low-E Packing Series of low emission packing provides best in class performance that has been 3rd party independently tested and verified. While the term "Low-E Valves" refers to valves that have been tested by the manufacturer to an average that does not exceed < 100 ppm, the Masoneilan Low-E Packing series far exceeds these expectations.

- EPA's "Certified Low-Leak technology" (CLLT) compliance and certificates
- Tested with both methane and helium media to ISO 15848-1
- Tested for high and cryogenic temperatures
- 4 Thermal cycles and 100,000 mechanical cycles (CC3)
- Independent third-party verification
- Field retrofit kits available for existing Masoneilan control valves

Design Considerations

In order to reduce emissions through a control valve, it is important to understand potential sources of leakage and ensure appropriate design and assembly procedures to minimize leakage through these joints. For a typical control valve, there are three potential sources of leakage. See Figure 1 & 2.

1. Stem-seal packing box interface
2. Pipeline flange gasket joint *(outside valve supplier scope)*
3. Body-bonnet gasket joint

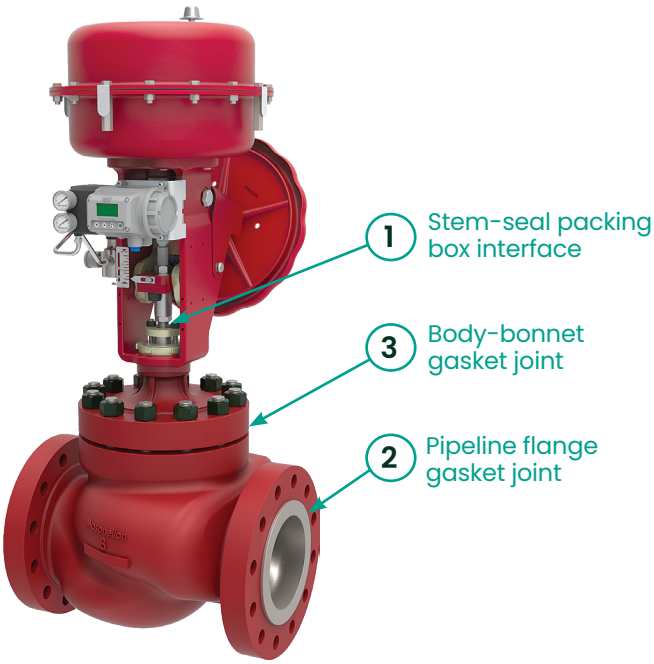

Figure 1 - Reciprocating valve

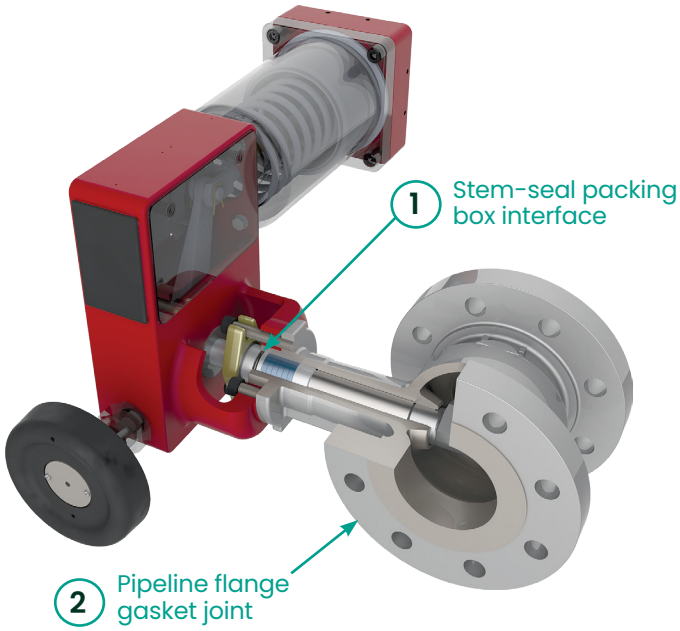

Figure 2 - Rotary valve

Body to bonnet gasket joint and pipeline flange gasket joints are static, where joints are bolted together, with a sealing gasket installed in between the joints. To meet low emission requirements, it is critical for the valve manufacturer to pay close attention to 1) gasket joint; its material, thickness, surface roughness and serration, and to 2) ensure appropriate torque forces are applied on the bolts. Figure 2 shows a cross-section of a typical rotary control valve. As with globe style valves, the pipe flange gasket joints and the stem-seal packing box interface are potential paths for process fluid to leak into the environment. However, many rotary style control valves have an integrated body and bonnet, eliminating a potential leak path as a total emissions source.

A key advantage of rotary control valves in managing fugitive emissions is the rotating motion of the valve stem, as the valve is opened and closed. The stem stays within the stem seal or packing area, minimizing the possibility of introducing foreign particles or debris into the sealing interfaces. As a result, these valves are typically more effective in reducing fugitive emissions leakage, and normally deliver greater reliability and operating efficiency from this perspective.

Another key contributor to packing wear in linear control valves and, thus, another source of potential fugitive emissions is the presence of foreign particles or debris in the surrounding atmosphere. Since a globe valve strokes in a linear motion, the valve stem moves up through the packing area as the valve opens, and then moves back down into the packing area as the valve closes. As the valve cycles from open to close, a portion of the stem is exposed to the environment, creating an opportunity for particles to attach to the stem surface and potentially impact the packing wear rate and sealing capabilities. These particles also can increase the operating friction, which reduces the overall responsiveness and controllability of the valve. For a rotary style control valve, the stem is rotating within the packing and is not exposed to the external environment, therefore, the risk to the packing box due to foreign particle introduction is minimal.

Solutions

Masoneilan offers 2 styles of Low-E packing, depending on valve operation. (See Tables below) All Low-E packing has been tested to ISO 15848-1 standard with Methane and Helium. Low-E packings tested to methane fluid are CLLT certified.

Table 1. Rotary Packing

Packing Designation	Model No.	Size	Max ASME Class	Max Temp °C (°F)	Packing Material	Test Standard	Endurance Class	Test Fluid	Tightness Class	CLLT Compliance
Low-E R4D	35002	1"-12"	600	400 (750)(1)	Teflon	ISO 15848-1	CC3	Helium	B	N/A
Low-E R6C				400 (750)	Graphite			Methane	A	Yes

Note (1): Certified for cryogenic applications with minimum rated temperature -196°C (-320°F).

Table 2. Reciprocating Valve Packing - Methane

Packing Designation	Model No.	Size	Max ASME Class	Max Temp °C (°F)	Packing Material	Test Standard	Endurance Class	Test fluid	Tightness Class	CLLT Compliance
Low-E L13A	10000	¾"-12"	1500	350 (660)	Teflon	ISO 15848-1	CC3	Methane	Class A	YES
	21000	¾"-8"								
	41005	2"-18"								
	78400	1"-2"								
	79000	1"-6"								
	80000	¾"-12"								
	18400	1"-2"								
Low-E L14	10000	¾"-12"			Graphite					
	21000	¾"-8"								
	41005	2"-18"								
	78400	1"-2"								
	79000	1"-6"								
	80000	¾"-12"								
	18400	1"-2"								
Low-E L17	18400	3"-8"	2500	316 (600)	Teflon					
	49000	3"-30"								
	78400	3"-8"								
	77000	1"-6"		350 (660)						

Table 3. Reciprocating Valve Packing - Helium

Packing Designation	Model No.	Size	Max ASME Class	Max Temp °C (°F)	Packing Material	Test Standard	Endurance Class	Test Fluid	Tightness Class	CLLT Compliance
Low-E L17	18400	3"-8"	2500	316 (600)(1)	Teflon	ISO 15848-1	CC3	Helium	Class A	N/A
	49000	3"-30"								
	78400	3"-8"								
	77000	1"-6"		500 (932)					Class B	

Note (1): Certified for cryogenic applications with minimum rated temperature -29°C (-20°F).

Masoneilan Low-E Packing Design

Reciprocating Low-E Packings

Low-E L13A, Low-E L17(1): PTFE Base

External Live Loading Standard with seal rings which vary by stem size, 2 Anti-extrusion rings.

Options available: Packing with O-rings
Fire Proof, CLLT Certificate

Low-E L14: Graphite Base

External Live Loading Standard with seal rings which vary by stem size.

Options available: Packing with O-rings
Fire Proof, CLLT Certificate

Note (1): L17 offers a lower friction factor

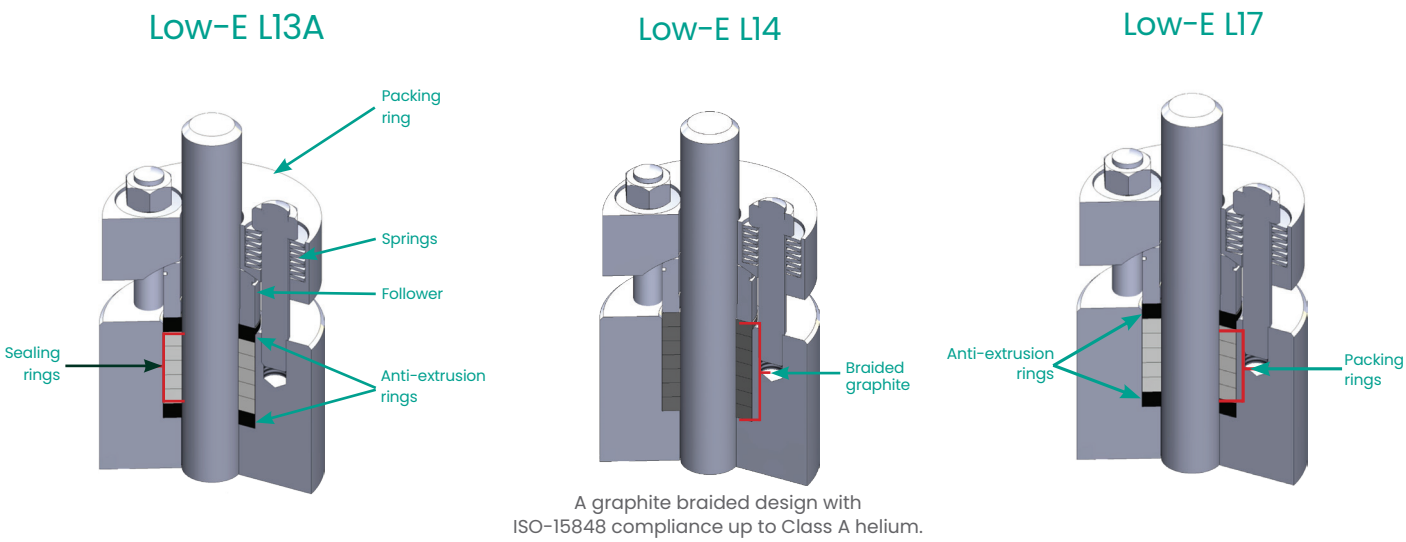

Figure 3 - Reciprocating valve packing design

Rotary Low-E Packings

R4D: PTFE Base

Packing follower with O-rings
Standard with 5 sealing rings,
2 Anti-extrusion rings.

Options available: CLLT Certificate

R6C: Graphite Base

Packing follower with O-rings
Standard with 7 sealing rings.

Options available: CLLT Certificate

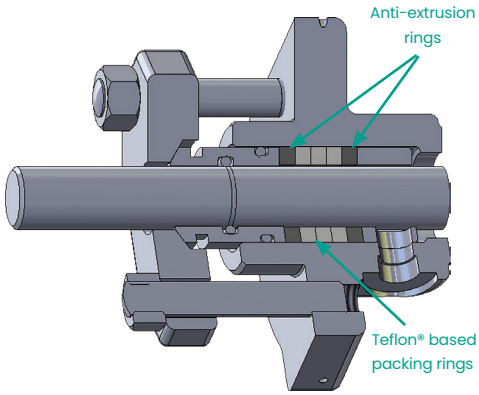

Figure 4 - Rotary valve packing design

Fugitive Emissions Requirements

Fugitive emissions requirement are governed by various regulatory bodies and differ by region. In Europe, ISO 15848-1 is the most commonly accepted test standard for low emission valves. In North America, the American Petroleum Institute (API) standards are more commonly specified. However, it must be noted that typical API standards (API-622, API-624 and API-641) apply to isolation valves, and typically require mechanical cycles in the range of 310-1510, and thermal cycles in the range of 3-5. These API standards do not apply to control valves which are operated at higher cycles, both mechanically and thermally. The table below summarizes the test criteria for each of the common test standards mentioned within the industry today.

Table 4. Fugitive Emission Qualification Standards

	Application	Mechanical Cycles	Thermal Cycles	Pressure	Fluid	Method	Packing Leak Rate
ISO 15848-1	Control & On-Off Valves	**Control Valves:** CC1 (20k cycles) CC2 (60k cycles) CC3 (100k cycles)	**Control Valves:** CC1 (20k cycles) CC2 (60k cycles) CC3 (100k cycles)	Mfg. Defined	Helium	Isolated vacuum atmosphere	A: 1.78x10^{-7} mbar. L / s(1) B: 1.78x10^{-6} mbar. L / s(1) C: 1.78x10^{-4} mbar. L / s(1)
		On-Off Valves: CO1 (205 cycles) CO2 (1500 cycles) CO3 (2500 cycles)	**On-Off Valves:** CO1 (2 cycles) CO2 (3 cycles) CO3 (4 cycles)		Methane	Sniffing	A: ≤ 50 ppm B: ≤ 100 ppm C: ≤ 500 ppm
ANSI / FCI 91-1	Control Valves	A (100k cycles) B (25k cycles) C (100k cycles) D (25k cycles) E (5k cycles)	A (3 cycles) B (3 cycles) C (0 cycles) D (0 cycles) E (1 cycles)	Mfg. Defined	Methane	Sniffing	CL 1: 100 ppm CL 2: 500 ppm
API 622	On-Off Valves	1510	5	600 psi (41.4 bar)	Methane	Sniffing	500 ppm
API 624	On-Off Valves	310	3	600 psi (41.4 bar)	Methane	Sniffing	100 ppm
VDI 2440	Not Defined	Not Defined (typ. 500-2000)	Not Defined	Not Defined (typ. 40 bar)	Helium	Isolated vacuum atmosphere	T: ≤ 250°C :10^{-4} mbar . L / s(1) T: ≥ 250°C :10^{-2} mbar . L / s(1)

Note (1): per mm stem diameter

The U.S. Environmental Protection Agency (EPA) has set fugitive emissions limits to be met by the industry. The general limit in existence today is 500 ppm.

CLLT is general terminology used by the EPA which covers requirement for both "Low-E Packing" and "Low-E Valve". EPA's consent decree provide definitions for these terminologies as follows:

Low-Emissions Packing or Low-E Packing shall mean:

- A valve packing product, independent of any specific valve, that has been tested by the manufacturer or a qualified testing firm pursuant to generally-accepted good engineering practices for testing fugitive emissions, and that, during the test, at no time leaked at greater than 500 ppm, and on average, leaked at less than 100 ppm.

Low-Emissions Valve or Low-E Valve shall mean:

- A valve (including its specific packing assembly) that:
  1. Has been tested by the manufacturer or a qualified testing firm pursuant to generally-accepted good engineering practices for testing fugitive emissions and that, during the test, at no time leaked at greater than 500 ppm, and on average, leaked at less than 100 ppm; or
  2. Is an Extension of another valve that qualified as "Low-E" (under point 1 above).

Fugitive Emission Specifications

Using independent 3rd party test agencies, Masoneilan has qualified the product ranges to the following tests results using Methane and Helium to 100,000 cycles. Methane was used to test up to 350°C (662°F) while Helium was used at temperatures up to 500°C (932°F).

Product Series	EPA Requirement (2)	Actual Test (1)
35002 (Camflex™)	<100 ppm	1 ppmv
37002	<100 ppm	< 2 ppm
18400 / 78400 (LincolnLog™)	<100 ppm	< 7 ppm
49000	<100 ppm	< 7 ppm
10000	<100 ppm	< 15 ppm
21000	<100 ppm	< 15 ppm
41005	<100 ppm	<15 ppm
71000	<100 ppm	<15 ppm
72000	<100 ppm	<15 ppm
77003	<100 ppm	<8 ppm
80000	<100 ppm	<15 ppm

Note: (1) Based on Methane results
(2) If operating under a recent consent decree

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