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ISO 15848-1 Competitive Benchmark Testing & Design Comparison

Soft Seated Ball Valves

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Introduction

Purpose

This document will compare the ISO 15848-1 fugitive emission test results of the XOMOX® FK Soft Seated Ball Valve and two competing soft seated ball valve designs, noted as competitors A and B.

The test results are depicted in the following ways:

- Actual external leakage measurement in graphical format.
- Pictorial end-results of any notable wear to the valve components during testing.
- Competitive comparison charts that highlight the design as well as features and benefits.

The testing performed was per ISO 15848-1, test procedure for evaluation of external leakage of valve stem seals (or shaft) and body joints of isolating valves intended for application in volatile air pollutants and hazardous fluids. ISO 15848-1 defines type test for evaluation and qualification of valves where fugitive emissions standards are specified.

ISO 15848-1 contains both dynamic life cycles and thermal cycles and is considered one of the most demanding fugitive emission test standards for soft seated valves. It requires the testing of completely assembled valves using either helium or methane as the test media and either the vacuum or sniffing method for leak detection.

These tests were performed using methane as the test media and leakage was measured using the sniffing method as defined by ISO 15848-1, Annex B. This test permits only one adjustment to the valve stem seal every endurance class. Valves were tested with the stem in the vertical position.

Stem leakage is categorized in tightness classes, AM, BM and CM for methane.

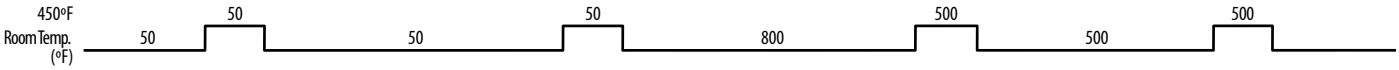
- Tightness classes for Methane:
  - Class AM should not exceed ≤50ppmv
  - Class BM should not exceed ≤100ppmv
  - Class CM should not exceed ≤500ppmv
- Endurances classes for isolating valve: (number of mechanical cycles)
  - CO1 -205 cycles
  - CO2 -1,500 cycles (additional 1,295 cycles)
  - CO3 -2,500 cycles (additional 1,000 cycles)
- The number of thermal cycles (ambient to temperature) included in the Endurances Classes:
  - CO1 two thermal cycle
  - CO2 one additional thermal cycle (3 total)
  - CO3 one more additional thermal cycle (4 total)

Fugitive Emission Test Results: Side-By-Side Data Comparison

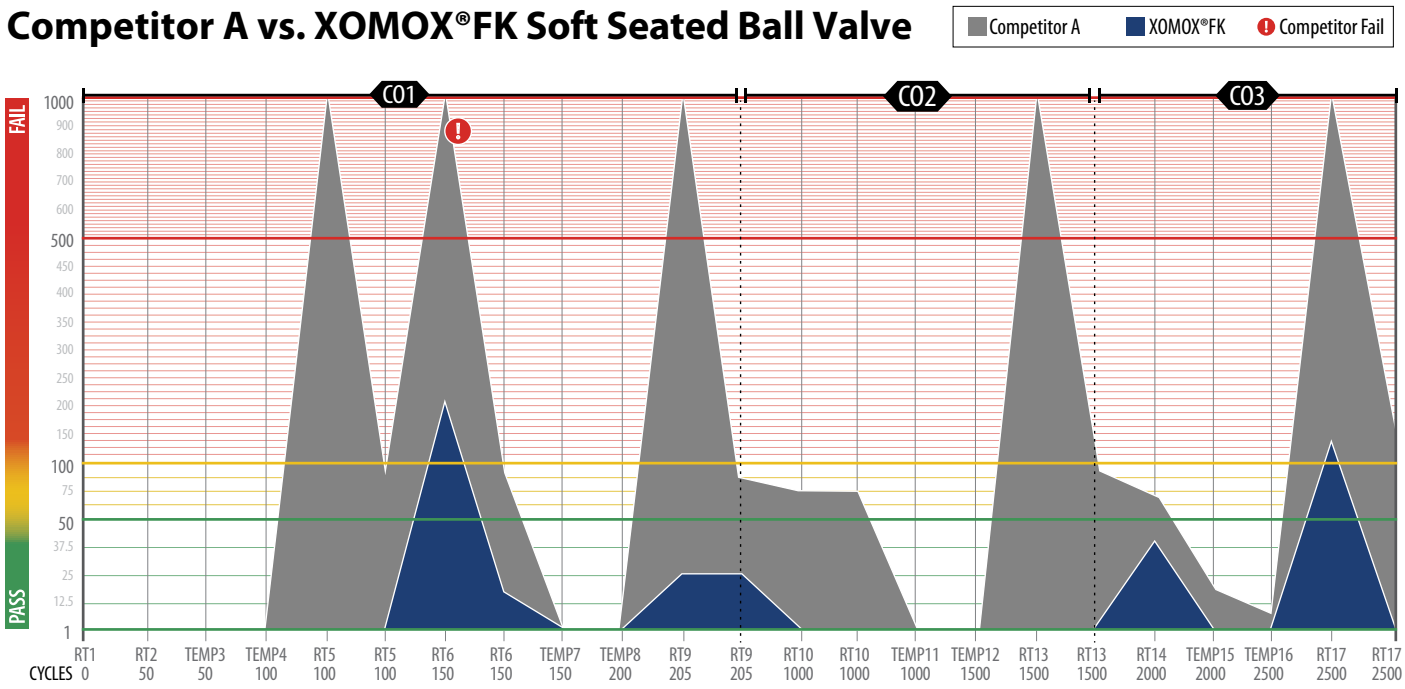
	XOMOX® FK Soft Seated Ball Valve	Competitor A	Competitor B
Achieved Endurance Class (Mechanical Cycles)	**CO3 PASSED**	**CO1 FAILED**	CO1 & CO2 PASSED **CO3 FAILED**
Achieved Stem Leakage Class	**AM (≤50)**	**FAILED**	BM (≤ 100)
In-Line Leakage (Helium*)	<0x10-6 cc/sec	<0x10-6 cc/sec	1.2x10-4 cc/sec

Note: When using Methane, ISO-15848-1 is typically run at 400˚F (200˚C), these tests were performed at 450˚F, which is the maximum temperature rating of the valve.

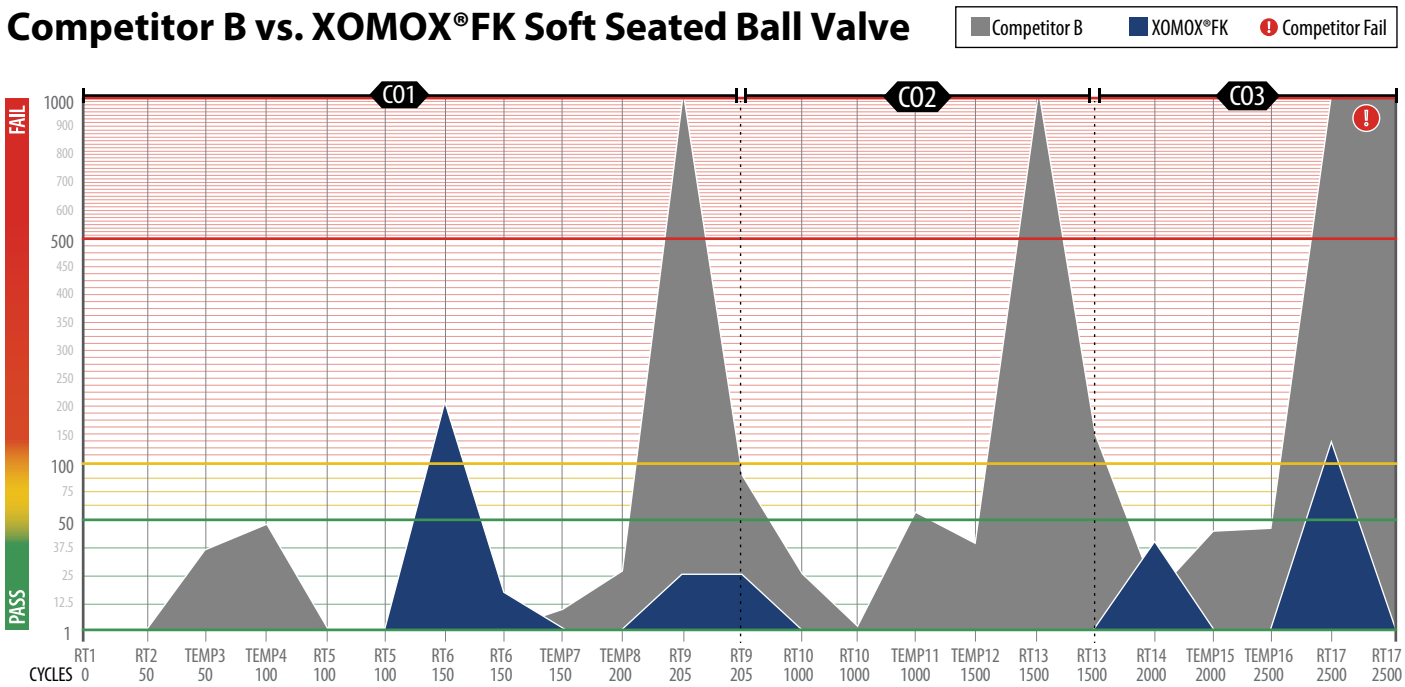
Competitors' Test Results vs. XOMOX®FK Soft Seated Ball Valve
2" Soft Seated Ball Valve - ISO 15848-1 Test - Class AM/CO3



Competitor A vs. XOMOX®FK Soft Seated Ball Valve



Competitor B vs. XOMOX®FK Soft Seated Ball Valve



Note: Adjustments made at any peak over 50 ppm. Per ISO 15848-1, one adjustment is allowed per each endurance class.

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Visual Test Results of XOMOX®FK Soft Seated Ball Valve

XOMOX®FK Soft Seated Ball Valve

The Xomox FK ball valve has 22 components as compared to the other three competitors (30pcs, 31pcs & 52pcs).

During the ISO 15848-1 test, it required a total of two (2) adjustments. The first leak measured just 200ppm after the first thermal cycle which was in endurance class CO1, the second leak was at the end of the test, measuring just 130ppm after the final measurement, 2,500 cycles at 285psi. After adjustment 0ppm was achieved.

Test results achieved:
ISO FE AM-CO3-SSA2-RT, 450°F-CL150-ISO15848-1

This valve incorporates three independent stem seals. 1st seal is the patented pressure-assisted SX chemically modified PTFE stem seal, 2nd seal is a spring energized (live loading) lip seal Carbon filled PTFE, 3rd seal is graphite packing.
No visible extrusion of any of the three seals.

Visual Test Result Comparison of Competitors

Competitor A Ball Valve

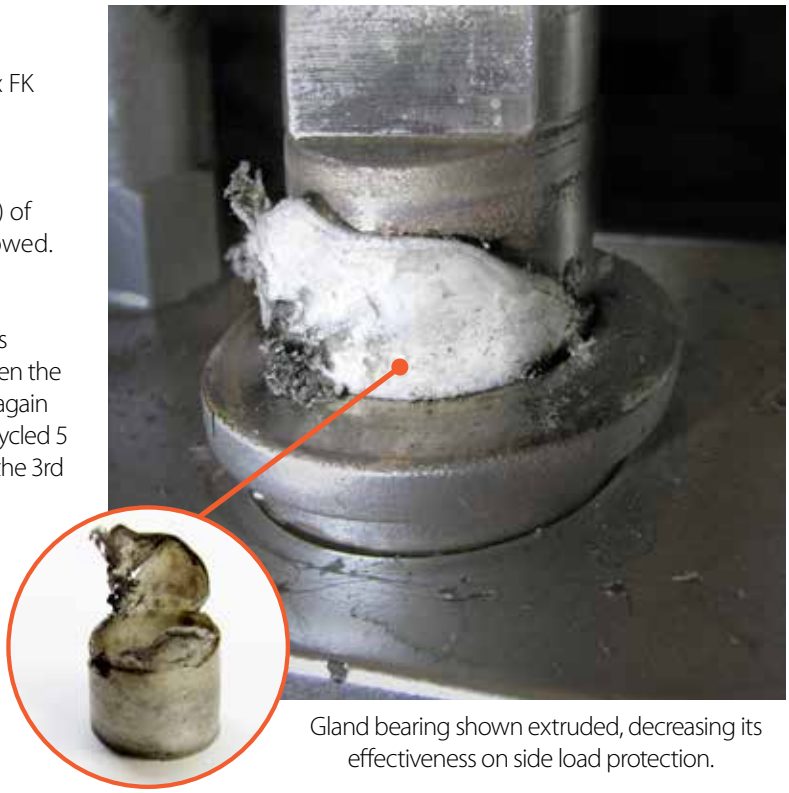
This valve has 31 components as compared to the Xomox FK which has 22 components.

During the ISO 15848-1 test, it required a total of five (5) adjustments, all measuring more than 1,000ppm, three (3) of which were in endurance class CO1 where only one is allowed. The valve is considered failed at this point.

The initial leakage was after the first thermal cycle. Packing was adjusted and the valve was cycled 50 more times which is when the second leakage occurred. Packing was adjusted again after the second thermal cycle. The valve was cycled 5 more times and again had to be adjusted for the 3rd time within the endurance class CO1.

Test results achieved: **Failed**

(Left) Cup and Cone Packing shown after disassembly, visible extrusion of packing rings around Stem O.D.



Gland bearing shown extruded, decreasing its effectiveness on side load protection.

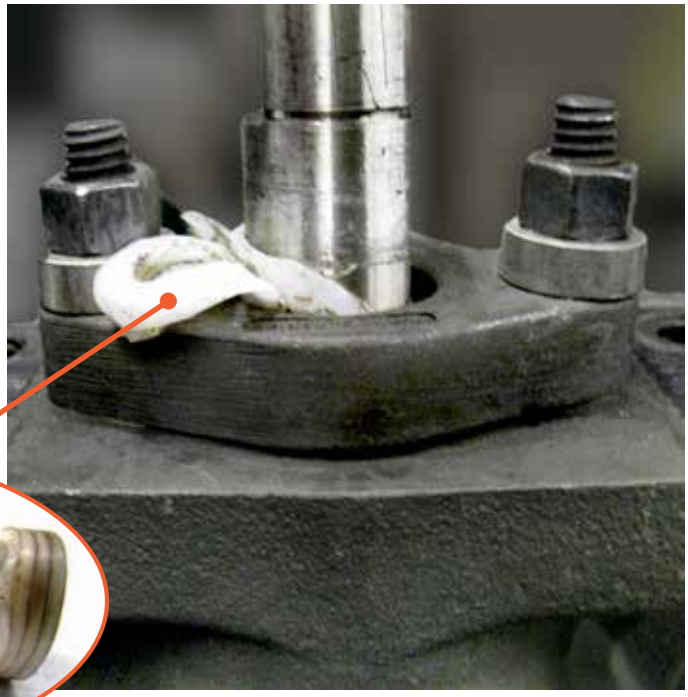
Competitor B Ball Valve

This valve has 30 components as compared to the Xomox FK which has 22 components.

During the ISO 15848-1 test, it required a total of three (3) adjustments, all measuring more than 1,000ppm; one (1) in each endurance class CO1, CO2 & CO3. However, the last leakage was unable to be adjusted out and this failed the last class CO3. The leakages were all after the thermal cycle in each endurance class.

Test results achieved:
ISO FE BM-CO2-SSA2-RT, 450°F-CL150-ISO15848-1

V-Ring type Packing shown after disassembly, visible extrusion of packing rings around Stem O.D.



Packing ring is shown extruded out the top of the gland follower and around Stem O.D. causing stem leakage.

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Feature and Benefit Comparison

		XOMOX ® FK Soft Seated Ball Valve	Competitor A	Competitor B
Stem	Material	UNS S31803 Duplex SS	316 SS	316 SS
	Material Yield Strength (psi)	58,740 psi	45,000 psi	45,000 psi
Stem Seal	Quantity	3	1	1
	Primary	Patented Pressure Assisted SX-TFM Stem Seal	Cup & Cone - PTFE	V-Ring Pkg. - PTFE
	Secondary	Spring Energized Lip Seal-PTFE/ Carbon filled/316ss	n/a	n/a
	Tertiary	Graphite Packing Rings	n/a	n/a
Live Loaded Packing		Yes	NO	NO
Body Gasket		Spiral Wound Dual Matl.: PTFE/Graphite	Spiral Wound Matl.: Graphite	Spiral Wound Matl.: PTFE
Fire Safe		YES	NO	NO
Quantity of Parts		22	31	30
Price		$$	$$	$$

Customer Pain Point	Best Practice
Continuous tightening of the industry maximum allowable leakage rates.	XOMOX®FK Soft Seated Ball Valve triple stem seal, designed specifically for the demanding fugitive emission services.
Fire safe valves require less efficient graphite stem seals to pass API-607.	XOMOX®FK Soft Seated Ball Valve incorporates both Teflon and Graphite seals, making this valve as standard, a fire safe design.
Thermal cycles are very challenging for most Teflon type Stem and Body seals.	• XOMOX®FK Soft Seated Ball Valve incorporates three different style/ types of stem seals to effectively seal in most service conditions. • XOMOX®FK Soft Seated Ball Valve incorporates two different materials in the body spiral wound gasket seal to effectively seal in most service conditions.

The Solution: XOMOX®FK Soft Seated Ball Valve

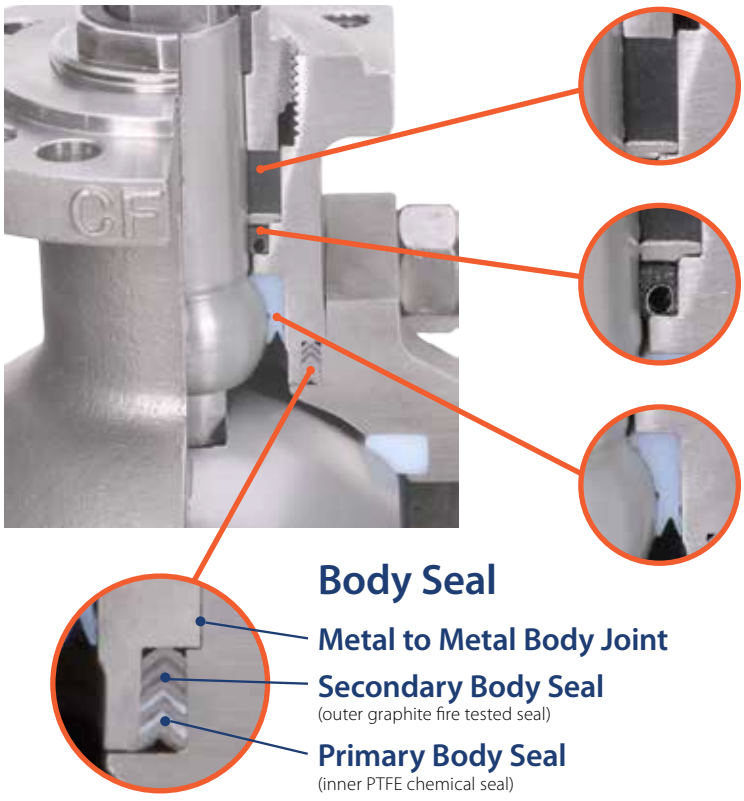
The new XOMOX®FK Soft Seated Ball Valve combines all critical safety and performance features required for demanding applications in the chemical process industry.

Key features:

1. Three independent stem seals offer superior fugitive emissions control, certified to the following standards: EPA Method-21, ISO-15848, and TA-Luft according to VDI 2440.
2. Self-relieving seats permit relief of excess pressure to protect the integrity of the valve, while maintaining bi-directional operation.
3. Patented SX ball-stem design provides high maximum stem torque capability and built-in side load resistance for extended valve life under severe conditions including thermal-cycling.
4. Dual material spiral wound body gasket, including a PTFE chemically inert inner seal and a secondary graphite outer seal, supplied as standard.

FIRE SAFE

Fire tested as standard per API 607-6th edition & ISO 10497:2010



Body Seal

Metal to Metal Body Joint

Secondary Body Seal
(outer graphite fire tested seal)

Primary Body Seal
(inner PTFE chemical seal)

Stem Seals

Tertiary Stem Seal (Adjustable)

The graphite packing arrangement is the third stem seal and can be adjusted if a leak is ever detected.

Secondary Stem Seal (Pressure Assisted)

The spring energized lip seal is the second independent stem seal; the spring is forcing the seal lips against the stem and the body ID while the pressure assists the spring force to create a superior seal. The spring compensates for lip wear, tolerances, eccentricities and provides permanent resilience (Live Loading) to the seal.

Primary Stem Seal (Pressure Assisted)

The innovative patented "pressure assisted" SX stem seal provides the highest protection against fugitive emissions while supplying superior side load resistance.

Thermal-Cycling Protection

To combat the effects of pressure and temperature fluctuations, dual material body gaskets are standard on Xomox®FK Soft Seated Ball Valves. This includes a PTFE chemically inert inner seal and a graphite outer seal combined into one spiral wound gasket. The spiral wound gasket design is industry proven, providing structural support and "Live Loading" via the metal spiral "V" shape rings and superior sealing of the dual materials.

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