



Fugitive Emissions Solutions From OMB Valves



Customer Requirements

- Emissions reduction for plant safety and environmental protection.
- Reduced product loss
- Less maintenance

Process Unit Emissions mostly come from Valves

- Refinery emissions are equally shared between process units, drains and tanks.
- 75% of process unit emissions come from pipeline valves.

Process Unit Emissions		
Components	% Leaking	% Total Fugitive Emissions
Pipeline Valves	3	75
Relief Valves	5.3	11
Pump Seals	9.2	5
Flanges	1	4
Compressor Seals	14.3	2

EPA Model Refinery (5 refinery study)

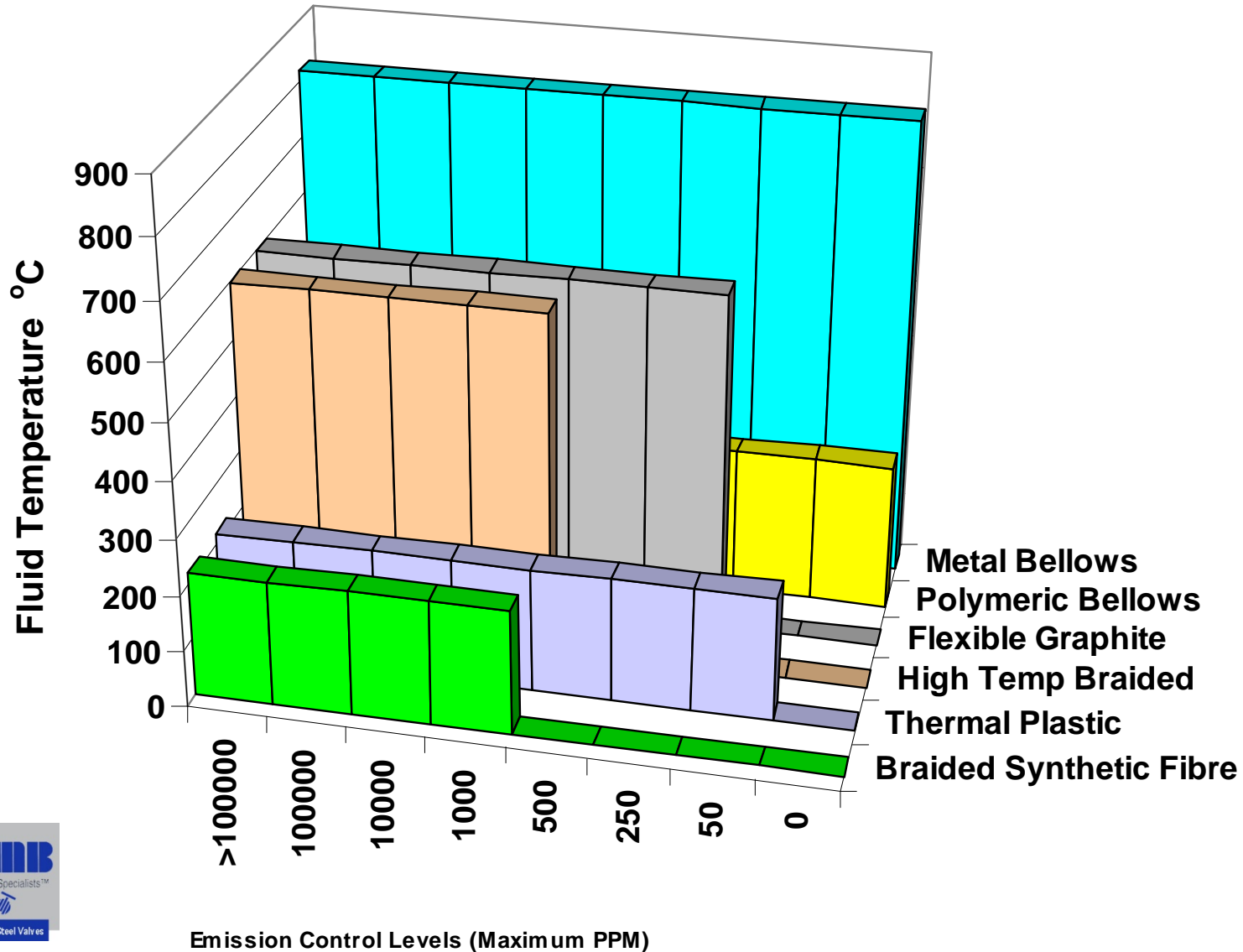
Valve Maintenance

- 50% to 85% of valve maintenance is related to the stem seal.
 - George Mc Killop STLE
- End-users try to reduce maintenance by specifying gland design and minimum standards for sealing materials.

Main Stem Seal Types

- Compression packing.
- Speciality
- Bellows
 - “A bellows seal is the most effective to prevent any fugitive emission where the process fluid is compatible and the cost can be justified.”
 - Frank Zezula. BP Group Research and Engineering Centre, Sunbury-on-Thames 16th Jan '96.

Valve Stem Seal Application Chart



Packing in use

Gland Packing Dimensions(mm)				
TYPE	A (O.D)	B (I.D)	H(Total Set Height)	Equivalent no. square rings
T2	15,7	9,53	19	5
T3	17,2	11,11	19	5
T4	17,2	11,11	26	5
T5	19,3	12,7	27	5
T6	26,3	16	30	5
T8	32,2	19,05	36	5
T25	26,3	14,5	30	5
T27	30,1	19,05	30	5
T918	36,2	22,23	48	5
T2513	30,1	16	38	5
T2528	39	25,4	60	6

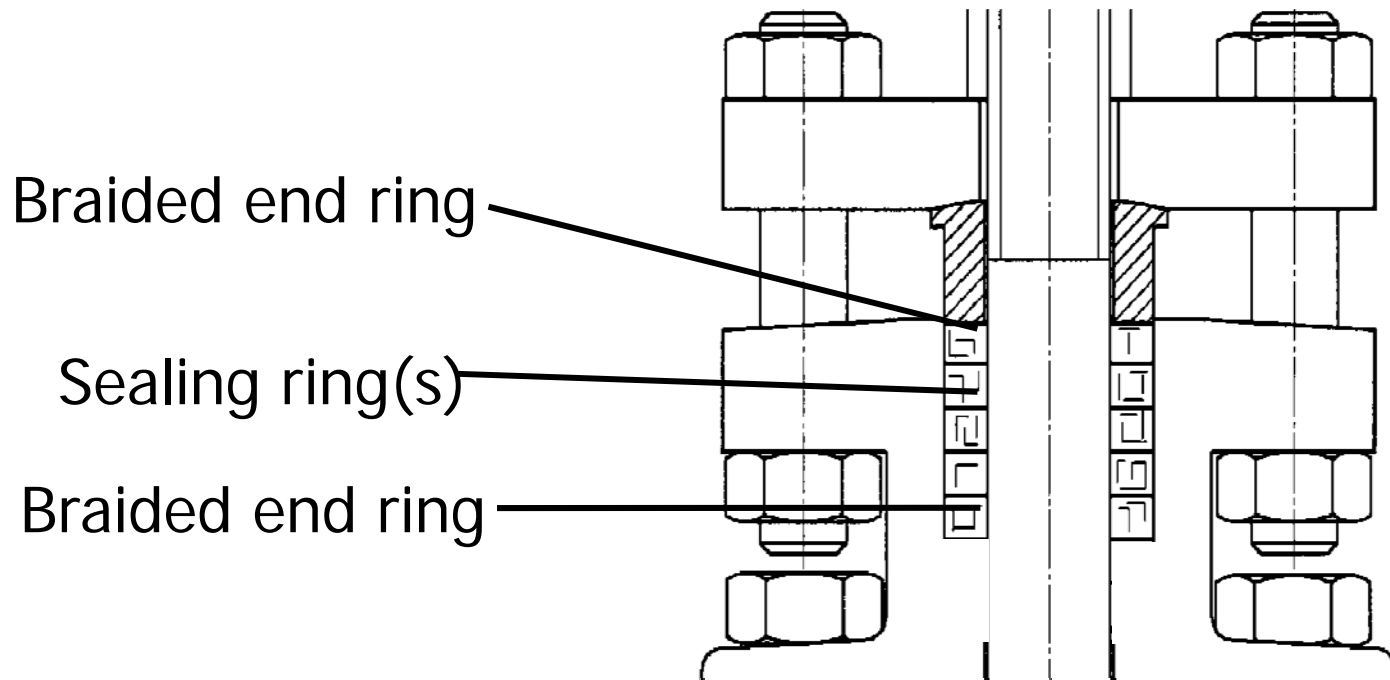
Gasket in use

Spiral Wound Gasket Dimensions(mm)

TYPE	A (O.D)	B (I.D)	C (Thickness)
40x30	40	30	3,5
48x38	48	38	3,5
54x44	54	44	3,5
66x54	66	54	3,5
74x60	74	60	3,5
79x67	79	67	3,5
95x78	95	78	3,5

Standard Graphite Packing

- Graphite combination packing
- Top and bottom rings pure preformed carbon fiber, acting as combined anti-extrusion and wiper rings.
- Intermediate flexible graphite sealing ring(s).



Std. Packing Specification

- **Sealing Rings in pure flexible graphite with corrosion inhibitor**
 - Density 1.65 g/cm³
 - Purity min. 98% graphite
 - max 50 ppm chlorides to ASTM C871
 - max 700 ppm sulphur to ASTM D129
 - max 1800 ppm iron
- **Braided Wiper/Anti-Extrusion Rings in 98% pure carbon fibre.**
- Temperature range of packing combination set: -200°C to +540°C (up to 600°C for Steam only)

Specification Compliance



- The packing design comply with API602 ed.8th 2005 / ISO15761 para 5.9 Packing, packing chamber and gland

5.9.1 The minimum uncompressed total height of the installed packing, h_p , shall be in accordance with Table 10. The packing height values in Table 10 are directly related to the stem diameters shown in Table 9. When a stem diameter greater than that of Table 9 is used, the manufacturer shall determine if the uncompressed packing height needs to be increased.

Table 10 — Minimum uncompressed packing height

DN	Minimum uncompressed packing height, h_p mm		NPS
	Class 150, Class 300, Class 600, Class 800	Class 1500	
8	12	22	¼
10	12	22	⅜
15	15	22	½
20	15	25	¾
25	25	30	1
32	25	38	1¼
40	28	38	1½
50	28	38	2
65	31	44	2½
80	38	47	3
100	44	50	4

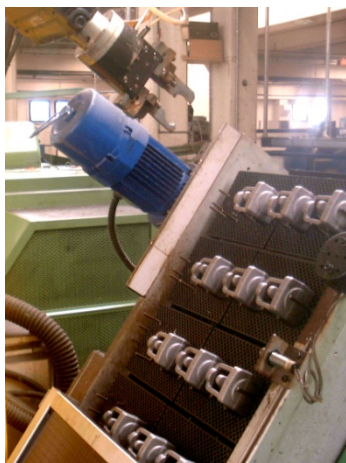


Specification Compliance



- The stuffing box clearances comply with API602 ed.8th 2005 / ISO15761 para 5.9 Packing, packing chamber and gland

5.9.2 The packing chamber bore shall have a surface finish, Ra , of 3,2 μm or smoother. The bottom of the packing chamber shall be flat.



Robotized machining units and specially designed tools ensure consistent quality on high volume production batches



Specification Compliance

- The OMB standard packing meets the requirements of most major end-users.
- The stuffing box clearances also comply with specific customer standards (i.e. Shell)

Specification Compliance

- OMB valves meet the requirements of the USA Clean Air Act.
- Testing per

1151

METHOD 21 - DETERMINATION OF VOLATILE
ORGANIC COMPOUND LEAKS

New Valve Emission Performance

- Using Helium gas and a detector with sniffer attachment US Method 21 gland leakage from new valves is **guaranteed less than 100ppm.**
(Testing procedure available on request)
- Bonnet gasket leakage is guaranteed to be 0 ppm.

Approvals & Qualification

TUV TRB801

TUV Bayern
since 1996

TA-LUFT Emission Test

TUV Bayern
certified valves since 1998

- Gate, globe and check
- Eco-L-Valves
- Bellows Seal Valves
- Ball Valves

New Developments in Emission Control

- Attempts to qualify valve emission performance based on “realistic” testing.
- Testing includes mechanical and thermal cycles to simulate plant operation.
- Valves are classified according to emissions performance achieved against a particular test procedure.

New Developments in Emission Control

- ISO specification since beginning of 2007
ISO 15848-1
the specification introduce a Type Test and a Production test method for qualification
OMB performed tests in 2005
- BP were the first to qualify on-off bulk supplied valves in this way (ISA testing)
OMB qualified the valves in 2003
- Shell have adapted the principle for their own emission testing specification 77/312.
OMB qualified the valves in 2003
- The API 622 specification: introduced in 2004.
OMB qualified the valves in 2008



BP *EVFP Qualification*

- OMB valves were fitted with Garlock EVSP 9000 (FVP) gland packing to meet BP's qualification requirements
- BP used **ISA – DS93.0.01** Standard Method for the Evaluation of External leakage of Manual and Automated On-Off Valves.



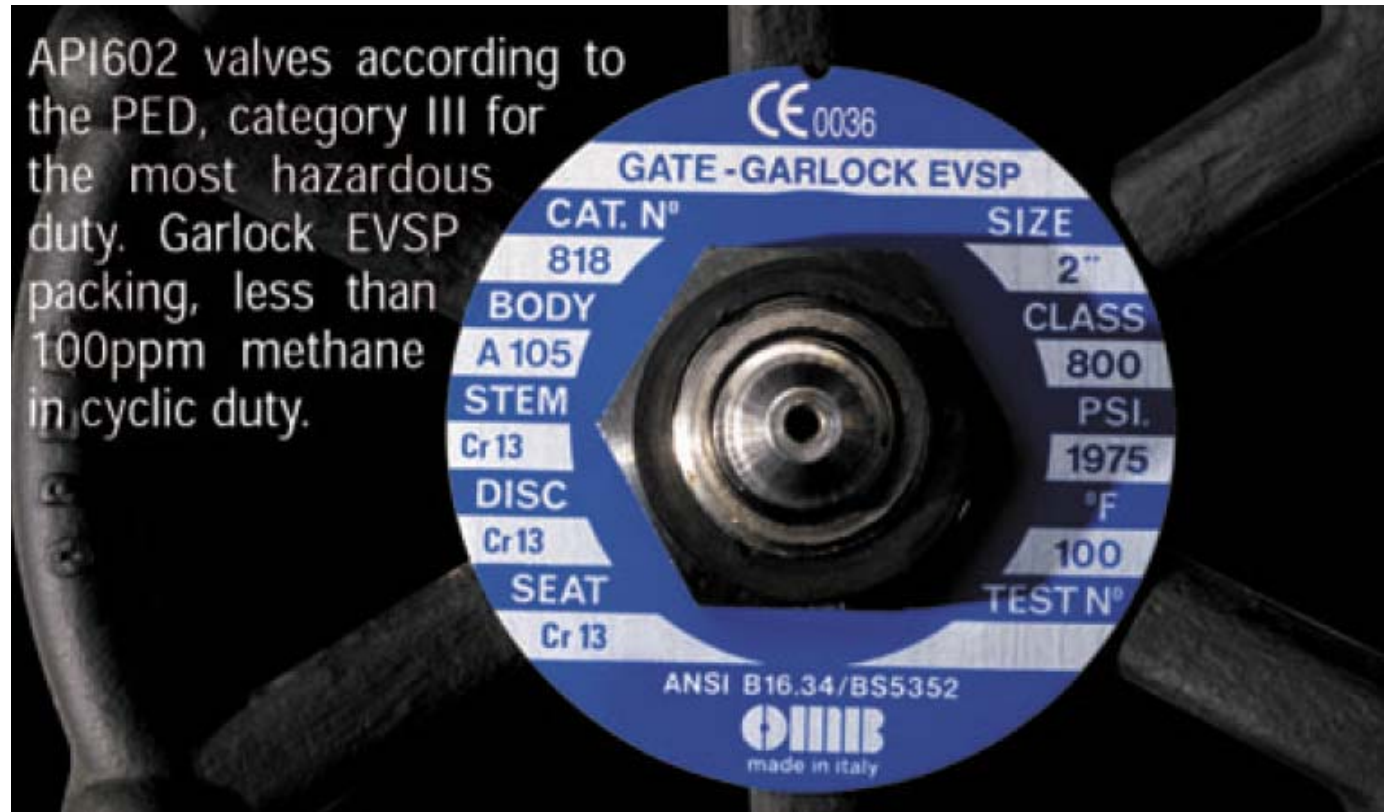
Garlock 9000 FVP Emission Test

- All exceeded 3 thermal cycles with 1 re-tighten.
- Mechanical cycling of the valves was by hand operation.
- Valves were electrically traced and lagged and heated using a temperature controller to thermally cycle 20-200-20°C five times.

Valve No	Max allowable Leakage ppm	Mechanical cycles completed	Thermal cycles	No of seal adjustments @ n cycles
1	100	100	5	1 @ 85
2	100	100	5	1 @ 65
3	100	90	4	1 @ 40
4	100	100	5	1 @ 70
5	100	90	4	1 @ 40
6	100	100	5	1 @ 50
7	100	100	5	1 @ 40
8	100	90	4	1 @ 40

Garlock 9000 FVP Packing

- Valves fitted with Garlock EVSP9000 FVP come with special nameplate to identify the packing type.



Approvals & Qualification



BP Chemicals

Environmental Friendly Valve

since 2001

Emission Test

3rd part laboratory (UK)

- 1000 operational cycles
- 2 Thermal cycles
- Garlock EVSP9000 FVP
- -100PPM



ARMASEAL 312 Specification

- Sealing Rings in pure flexible graphite with corrosion inhibitor

- T/B Density 1.85 g/cm³
- Int. Density 1.65 g/cm³
- Purity min. 98% graphite
- max 50 ppm chlorides
- max 700 ppm sulphur
- max 1800 ppm iron

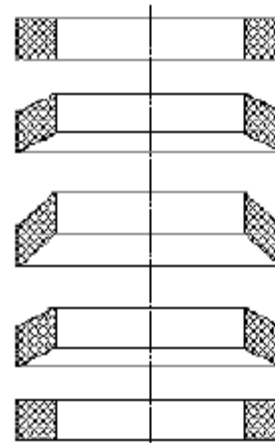
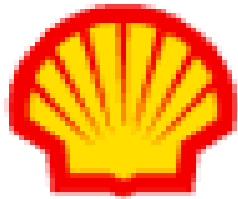


Fig : Sample Drawing

- TOP & BOTTOM RINGS Die-Formed Graphite Sealing Rings reinforced with stainless steel mesh.
- The top & bottom rings are produced from pure graphite.

- Temperature range of packing combination set: -200°C to +540°C (up to 600°C for Steam only)
- Developed by CMD srl, in use since 2003

type ARMASEAL 312



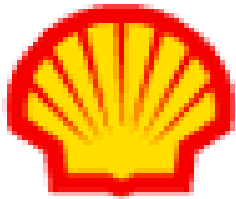
Shell 77/312 *Qualification*

- OMB valves were fitted with special designed packing (model Armaseal 312) developed internally with CMD srl (OMB std packing supplier)
- Type Test is based on 15848-1 and is performed during the Type Approval Test (TAT) in accordance to Shell Global Solutions procedure

Procedure and Technical Specification for
Type Acceptance Testing (TAT) of Industrial
Valves

Document Reference No. T-2.973.873



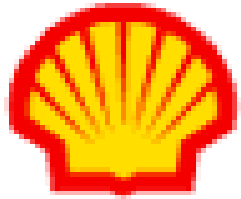


Shell 77/312 *Qualification*

- Type Approval Test is performed on specially designed equipment to meet Temperature requirements



Approvals & Qualification



Shell Global Solutions

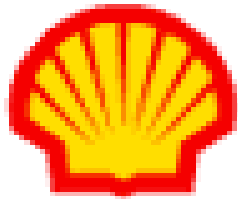
Fugitive Emission 77/312

since 2003

Emission Test

3rd part laboratory (NL) and internal Test

- 100 operational cycles
- Full Rating Pressure
- 2 Thermal cycles
- ARMASEAL 312 packing
- -70PPM (class B)



Shell 77/312 *Qualification*

type ARMASEAL 312



SHELL TAT - List of Valves to be Tested and Scheduling

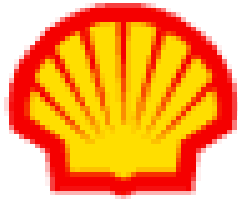
released
05/12/2007

test performed, failed, to be partly retested
test planned

	design	T2 973.873	Temp range	150-600	800	1500	2500
Gate Valves ISO 15761/ API602, Wedge Type, Metal Sealed, Rising Stem valves	std	page 51	-50 to 400C	done 02/07 77.20.33.104.1	covered by 2003 tests (2 star)	done 01/08 77.20.33.207.1	jan2008 failFE 77.23.36.25X.1
Gate Valves ISO 15761/ API602, Wedge Type, Metal Sealed, Rising Stem valves, Cryogenic	ext bonnet	page 52	-196 to 300c	done 02/07 77.23.08.104.1		done 02/07 77.23.08.204.1	jan2008 failFE 77.23.36.25X.1
Gate Valves ISO 15761/ API602, Wedge Type, Metal Sealed, Rising Stem valves, High Temp	std	page 52	0 -650C	done 10/07 77.23.30.104.1		done 01/08 77.20.33.207.1 up to 538C	
Globe Valves ISO 15761/ API602 (BS5352), Flanged, Plugball type	straight	page 52	-50 to 400C	done 02/07 77.30.33.104.1	??? (1) Pearl project 7731030531	done 01/08 77.30.33.204.1	done 12/07 -100C-400 Inconel625 (1)
Globe Valves ISO 15761/ API602 (BS5352), Flanged, Plugball type, Cryogenic	straight ext bonnet	page 54	-196 to 300c	done 02/07 77.33.08.104.1		done 02/07 77.33.08.204.1	
Globe Valves ISO 15761/ API602 (BS5352), Flanged, Plugball type, High Temp	straight	page 53	0 -650C	done 10/07 77.33.30.107.1		7734248081(pearl)	
Globe Valves ISO 15761/ API602 (BS5352), Flanged, Plugball type	Y pattern	page 52	-50 to 400C	st. 02/07 comp 07/07 77.31.56.105.1		done 12/07 77.34.70.255.1 from -29C	
Globe Valves ISO 15761/ API602 (BS5352), Flanged, Plugball type, High Temp	Y pattern	page 53	0 -650C	done 01/08 77.34.65.357.1		done 12/07 77.34.70.255.1	
Check Valves ISO 15761/ API602 (BS5352), Piston Type, Bolted cover	straight	page 60	-50 to 400C	done 12/07 77.10.33.105.1			pearl offshore
Check Valves ISO 15761/ API602 (BS5352), Piston Type, Bolted cover, cryogenic	straight	page 61	-196 to 300c			done 01/08 77.13.08.204.1	
Check Valves ISO 15761/ API602 (BS5352), Piston Type, Welded cover	straight	page 60	-50 to 400C	150-300 class covered by 2003 tests (2 star) (see bolted)		done 01/08 77.13.08.204.1	
Check Valves ISO 15761/ API602 (BS5352), Piston Type, Welded cover, Cryogenic	straight	page 60	-196 to 300c	done 07/07 77.13.08.053.1		done 01/08 77.13.08.204.1	
Check Valves ISO 15761/ API602 (BS5352), Piston Type, Welded cover, high temperature	straight	page 60	0 -650C	771363.107.1 (houdini)			done 12/07 77.13.78.255.1
Check Valves BS1868, Swing Type, Bolted cover, Cryogenic	straight		-196 to 300c	done w 41-77.13.08.108.1			done 10/08 77.17.37.25X.1
Ball valves Floating 1/2"-2" 150-300	2 pieces		-50 to 200C	done 10/07 77.00.33.655.1			
Ball valves 3" - 6"	2 pieces			fail 10/07 77.00.33.660.1			
Ball valves 8"-12"							



Approvals & Qualification



Shell Global Solutions

Fugitive Emission 77/312

since 2003

Gate, globe and check valves:

1/2" to 2"

150 to 2500 classes

Class B and Class A (with bellows seal)

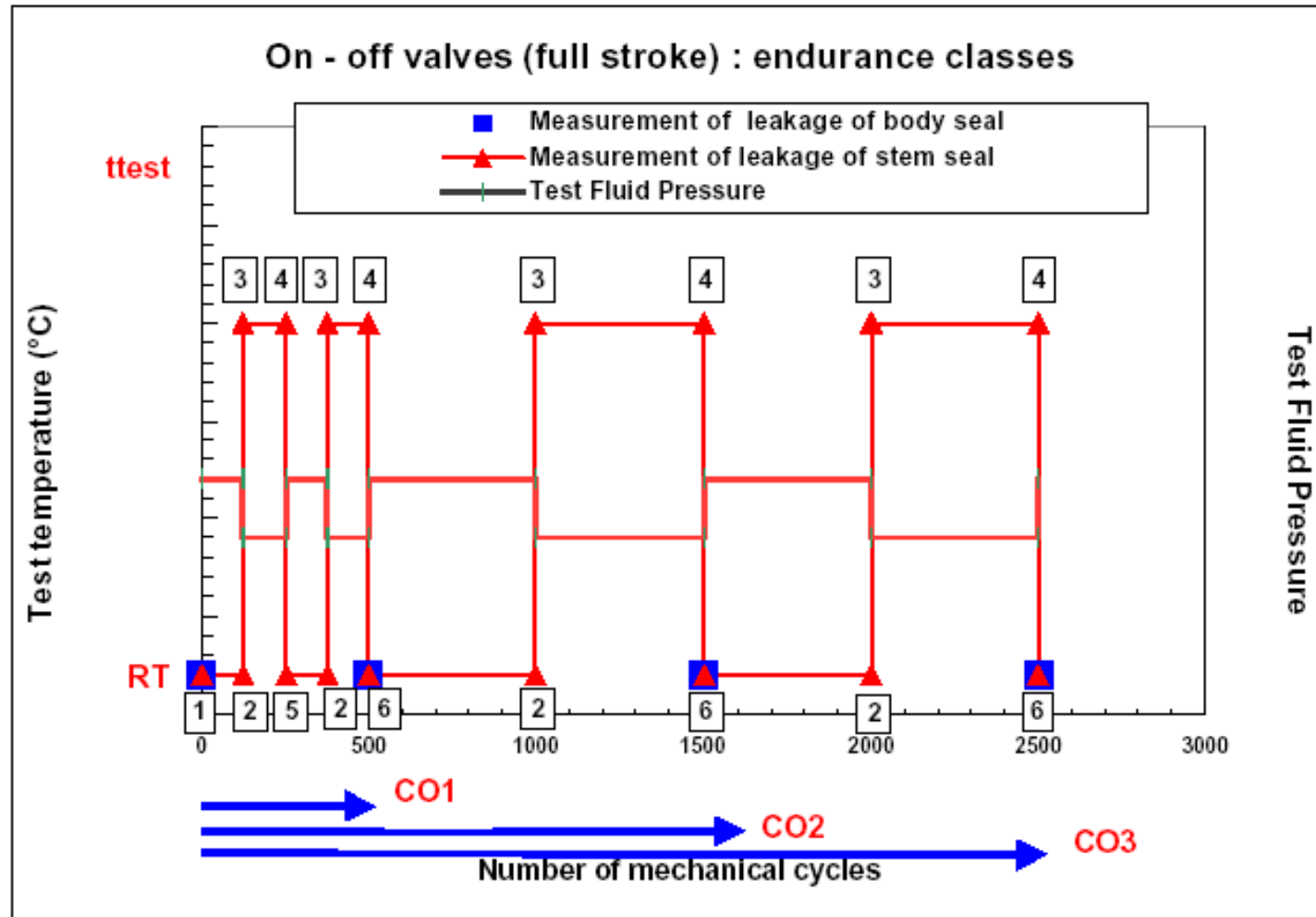
Ball valves

1/2" to 12"

150 to 600

Class A

ISO CD 15848 Emission Tests



NOTE The numbers 1 to 6 refer to the test sequences 1 to 6 as defined in 4.2.4.4 to 4.2.4.9.

Figure 3 — Mechanical cycles classes for on-off valves

ISO CD 15848 Emission Tests

OMB valves tested to ISO15761

With 3rd party certificates

Gate, globe and check valves:

½" to 2"

150 to 1500 classes

Class B

150 to 800 classes

Class A (with bellows seal)

Ball valves:

½" to 2"

150 to 600 classes

Class A



ISO 15848-1 Emission Tests

End User requirements

Within the ISO requirements, many end users added either specific test requirements (such as Total) or specific performance classes (no of cycles and temperature)

OMB has worked successfully in the past 3 years with the following end users for Type Test requirements on different projects:

- Agip KCO
- Neste Oil
- Total (downstream)

ISO 15848-1 Emission Tests

NESTE OIL

Neste Oil: project **WORLD SCALE NExBTL RENEWABLE DIESEL PROGRAM**

- **Requirements:**
 - 3. INSPECTION AND TESTING
 - 3.1. Fugitive emission testing
 - Valves shall be tested and approved according to EN ISO 15848-1 applying the following minimum classification criteria:
 - 1. Tightness class (helium or methane as test gas):
 - A for bellow seal valves
 - B for non-bellows seal valves in H2-recycling gas service in pressure classes 1500 and above
 - C for other valves/services
 - 2. Endurance class CO1
 - 3. Temperature class:
 - (t200°C) for duplex stainless steels, class 600 and above
 - (t400°C) for all other materials

ISO 15848-1 Emission Tests

NESTE OIL

Neste Oil: project **WORLD SCALE NExBTL
RENEWABLE DIESEL PROGRAM**

- Tested valves:
 - Gate, globe and Check
 - API602/ISO15761
 - size ½" to 2"
 - Class 800 and 1500
 - Covers 150 to 1500 classes

ISO 15848-1 Emission Tests



Agip KCO

AgipKCO: project **Kashagan Experimental Programme**

- Requirements:
ISO15761-1
- Class B
- Endurance C1 (500)
- Valves:
 - Floating Ball (soft and metal seated)
 - Globe and Needle



ISO 15848-1 class BH

Total: **French Downstream (refinery)**

- Requirements:
ISO15761-1
- Class BH
- Endurance: Special req.
- Valves:
 - ISO15761/API602 gate, globe and check



ISO 15848-1 class BH

Table 1 — Tightness classes for stem (or shaft) seals (fluid : helium)

Class	Measured concentration
CLASS AH	10^{-6} mg.s ⁻¹ .m ⁻¹ helium
CLASS BH	10^{-4} mg.s ⁻¹ .m ⁻¹ helium
CLASS CH	10^{-3} mg.s ⁻¹ .m ⁻¹ helium
CLASS DH	10^{-2} mg.s ⁻¹ .m ⁻¹ helium
NOTE Expressed in mg.s ⁻¹ .m ⁻¹ measured with global leakage method as defined in Annex A.	

Table 3 — Emissions from body seals for helium and methane

Measured concentration
≤ 50 ppmv helium
≤ 50 ppmv methane
NOTE Expressed in ppmv measured with the sniffing method as defined in Annex B.



ISO 15848-1 cycles

Série 1								
Sniffing (Pa.m ³ /s)	Global (Pa.m ³ /s)	Pressure (bar)	Bolt torque (m.daN)	Chronology	Cumulated strokes	Temperature (°C)	Temperature Stuf. box	Observation
Reniflage (Pa.m ³ /s)	Global (Pa.m ³ /s)	Pression (bar)	Serrage fouloir (m.daN)	Chrono- logie	Manoeuvres cumulées	Température (°C)	Température PE	pendant l'essai
4,67 ^E -05		50	12	1	0	20		Effort (60 N)
	6,45 ^E -04	50	12	2	0	20		
	5,12 ^E -04	50	12	3	30	20		
5,12 ^E -05		50	12	4	30	20		
	9,12 ^E -04	50	12	5	100	20		
	3,38 ^E -03	50	12	6	250	20		
	1,07 ^E -03	50	12	7	500	20		Effort (70 N)
1,28 ^E -04		50	12	8	500	20		
3,80E-05		40	12	9	500	260	176	
	1,20E-03	40	12	10	500	260	231	
	7,41E-04	40	12	11	530	350	186	
	1,04 ^E -03	40	12	12	600	350	314	
	1,25 ^E -03	40	12	13	750	350	320	
	1,41E-03	40	12	14	1000	350	317	Effort (82 N)

OMB Emissions Solutions

OMB Standard

VSP 9000 FVP

ARMASEAL 312

Bellows Seal

- Standard square section -100ppm maximum helium leakage in new condition.
- Garlock EVSP - 100ppm helium max.leakage after 100 mech.cycles and 3 thermal cycles.
- Armaseal 312 -70ppm @ high temp/high pressure with 100 cycling procedure
- Bellows sealed - Zero leak for bellows cycle life and full temperature range.

A brief note on Body GASKET seal

- API602 ed.8th / ISO15671 identify the minimum requirement for gasket design as:

5.5.2 Gasketed joints shall be of a design that confines the gasket and prevents its over-compression. At assembly, all gasket contact surfaces shall be free of heavy oils, grease and sealing compounds. A light coating of lubricant, no heavier than kerosene, may be applied if needed to assist in proper gasket assembly. The gasket, unless otherwise specified by the purchaser, shall be suitable for a valve temperature range of -29°C to 540°C .

5.5.3 Bonnet flange gaskets, unless otherwise specified by the purchaser, shall be spiral wound metal with a flexible graphite filler. The wound metal shall be of type 18Cr-8Ni or 18Cr-8Ni-Mo and of either regular or low carbon grade.