



By Late 1990's EPA Audits Findings – May or May Not Comply With Regulations

**Fugitive Emissions Reduction WAS Not Occurring**

100,000's of Leaks Extremely Large Numbers of Valves and Other Types Equipment

API 622 1<sup>st</sup> Edition 2007 , 2<sup>nd</sup> Edition 2011 & 3<sup>rd</sup> Edition 2018 – 15 Years Later

Enhanced LDAR Program (ELP) Required in Consent Decrees

ELP for 2<sup>nd</sup> & 3<sup>rd</sup> Consent Decrees Most 100ppm Leak Requirement

(500ppm and 250ppm no longer considered LOW E)

Valve Design & Manufacturing procedures changes required to reliably meet new low leakage requirements

Continuous decline in leaks with new industry standards is happening

Industry standards testing results – **Certified Low Leak Technology “CLLT”**

SPONSORED BY:



## VALVES – Fugitive Emissions Testing Standards

API 622 – **Packing** Valve Stems  
**Annex C – High Temperature Testing Procedure  
(NEW)**

API 624 – **Valves** Gate & Globe

API 641 – **Valves** Ball, Butterfly & Plug

ISO 15848-1 – Isolating & Control **Valves**

TALuft VDI 2440 – **Packing** Valve Stems

(End user specifications)

(Many test standards include  
additional testing to other standards)

## VALVES – Standards (Fugitive Emissions Required)

API 599 – **Plug** Valves

API 600 – **Gate** Valves

API 602 – **Gate & Globe** Valves

API 603 – **Gate** Valves CRA

API 608 – **Ball** Valves

API 609 – **Butterfly** Valves

API 623 – **Globe** Valves

**\*API, ISO, TALuft (VDI) Certification Is Considered Global Fugitive Emissions Compliance**

SPONSORED BY:



**Bray**

**EMERSON**

**MRC Global**



**ZWICK**  
ARMATUREN GMBH

## VALVES – Fugitive Emissions Testing Standards

### API 622 – Type Testing of Process Valve Packing for Fugitive Emissions MECHANICAL & THERMAL CYCLING

6

API STANDARD 622

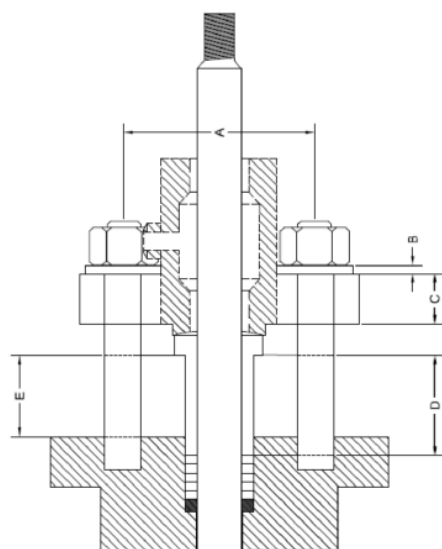


Figure 2—Test Fixture Bonnet

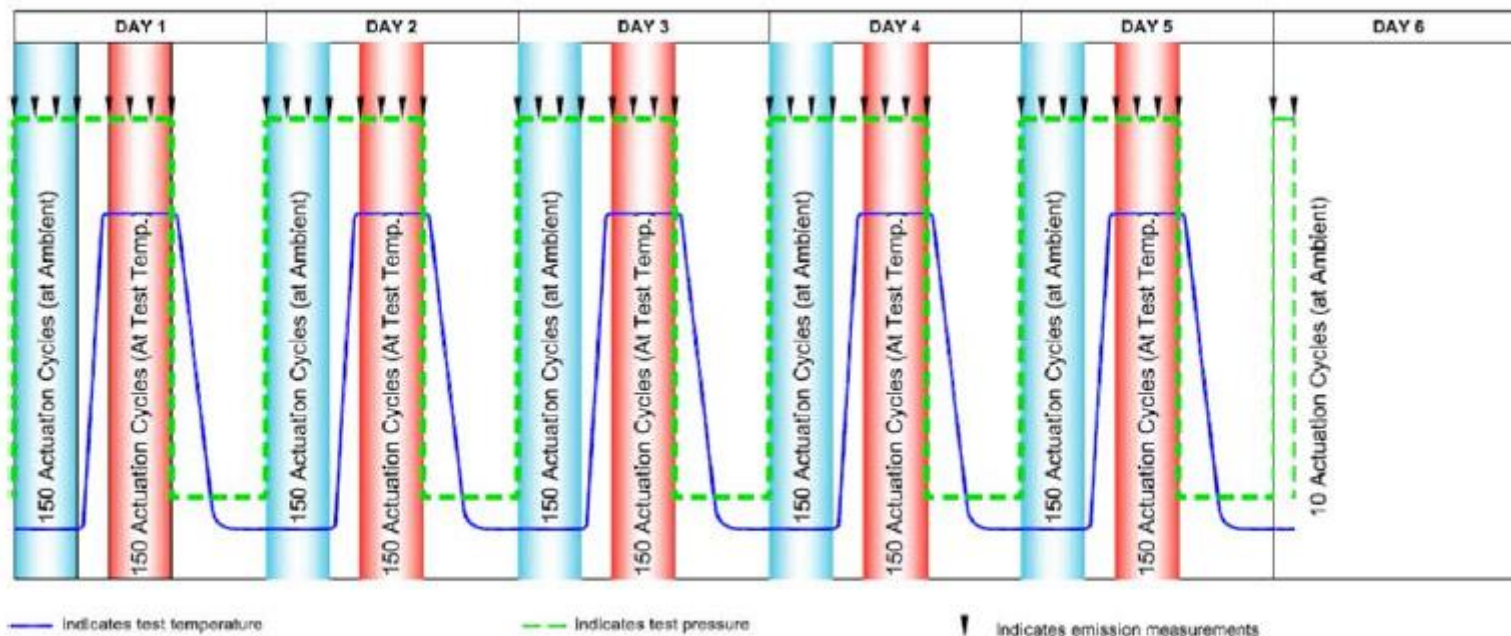


Figure 4—Mechanical and Thermal Cycling Diagram

Mechanical & Thermal 100 cycles, 50 cycles room and 50 cycles 500°F temperatures for 1500 cycles & final 10 cycles room temperature at 600 psig – NO PACKING ADJUSTMENTS & 100PPMV MAXIMUM LEAKAGE

SPONSORED BY:



Bray

EMERSON

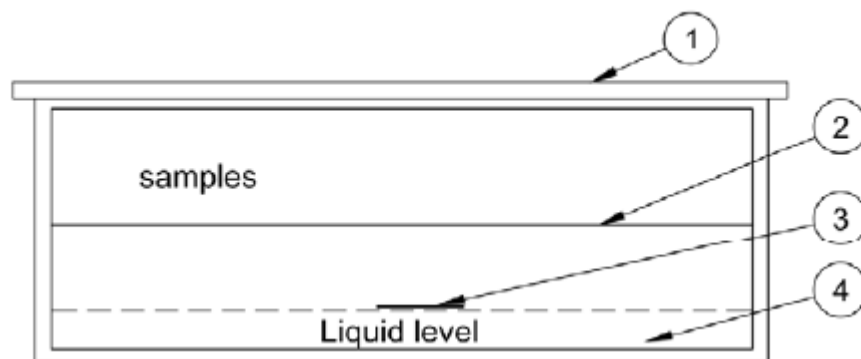
MRC Global



ZWICK  
ARMATUREN GMBH

## VALVES – Fugitive Emissions Testing Standards

### API 622 – Type Testing of Process Valve Packing for Fugitive Emissions AMBIENT CORROSION TESTING

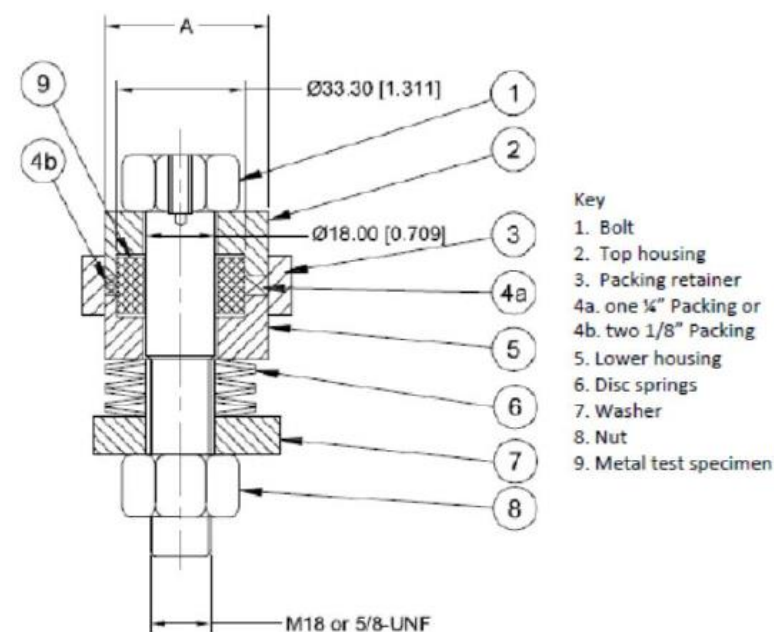


- Key**
- 1. Lid with perimeter seal
  - 2. Shelf
  - 3. Liquid level depth mark
  - 4. Liquid level 1/2 in. deep

**Figure 6—Corrosion Test Vessel**

14

API STANDARD 622



Test fixture 4350 psi compression stress for 28 days in containment vessel at room temperature

SPONSORED BY:



**Bray**



**MRC Global**



**ZWICK**  
ARMATUREN GMBH

## VALVES – Fugitive Emissions Testing Standards

API 622 – Type Testing of Process Valve Packing for Fugitive Emissions **HIGH TEMPERATURE CORROSION TESTING**

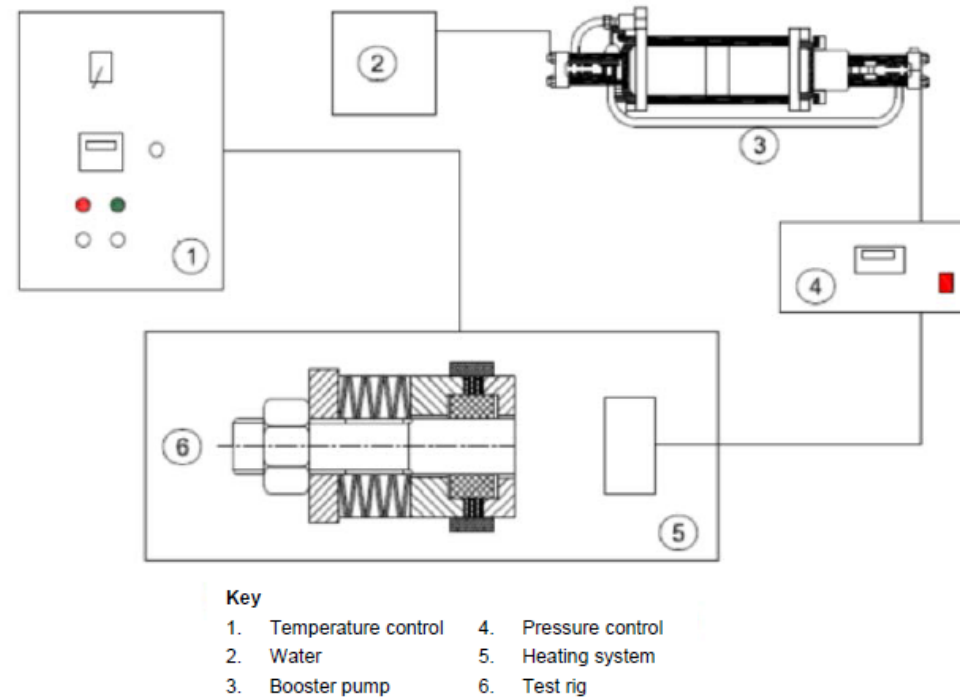


Figure 8—High Temperature Corrosion Test System

Test fixture 4350 psi compression stress, submerged in containment vessel for 28 days at 300°F and 650 psig

SPONSORED BY:



Bray

EMERSON

MRC Global

TEADIT  
Sealing for a Safer and Greener Tomorrow

ZWICK  
ARMATUREN GMBH



## VALVES – Fugitive Emissions Testing Standards

**API 622** – Type Testing of Process Valve Packing for Fugitive Emissions **PACKING MATERIALS TESTING**

Graphite Packing Ring Weight Loss Test Procedure – Increasing temperature increments to 1100°F for 24 hours

Density – weight/volume

Lubricant Content (PTFE)

fluorine content ASTM D1179 or D4327

Wet lubricant extract/original sample weight

Leachables – (packing with corrosion inhibitor)

Chloride testing ASTM D512

Fluoride testing ASTM D1179 or D4327 **\*REPORT PACKING MATERIALS TESTING TO BE INCLUDED  
WITH MECHANICAL & THERMAL CYCLING**

## VALVES – Fugitive Emissions Testing Standards

### API 624 – Type Testing of Rising Stem Valves Equipped with Graphite Packing for Fugitive Emissions THERMAL CYCLE TESTING

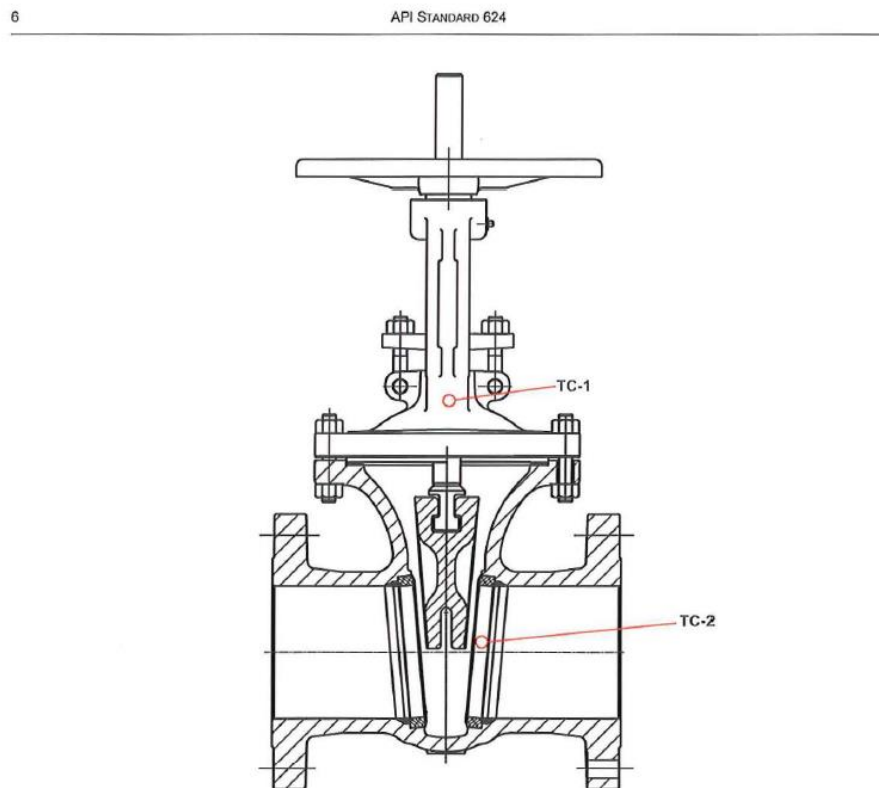


Figure 2—Temperature Locations

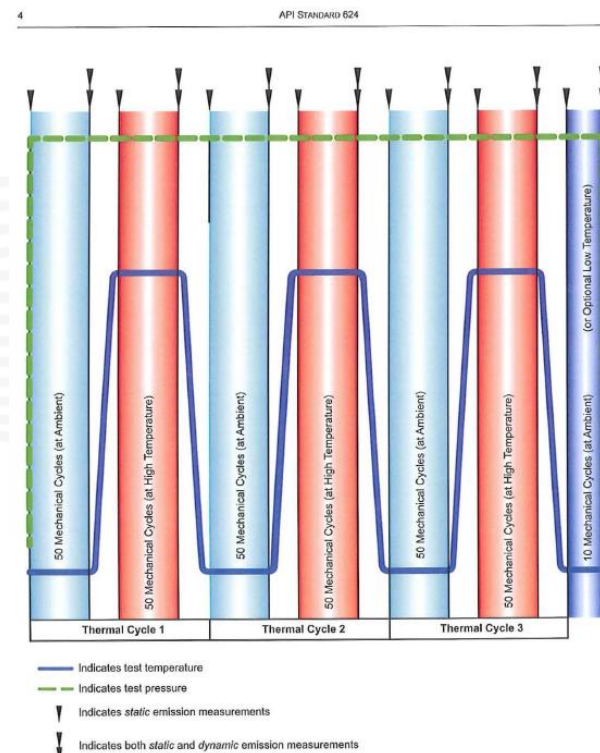


Figure 1—Valve Cycling

Mechanical & Thermal 100 cycles, 50 cycles room and 50 cycles 500°F temperatures for 300 cycles & final 10 cycles room temperature at 600 psig – NO PACKING ADJUSTMENTS & 100PPMV MAXIMUM LEAKAGE

SPONSORED BY:



**Bray**

EMERSON

MRC Global



**ZWICK**  
ARMATUREN GMBH

## VALVES – Fugitive Emissions Testing Standards

### API 624 – Type Testing of Rising Stem Valves Equipped with Graphite Packing for Fugitive Emissions **SUGGESTED VALVES TESTING**

Annex B  
(informative)

#### Suggested Valves for Testing

12

API STANDARD 624

Table B.1—Size and Class to be Tested for Each Gate Valve Made in Accordance with API 602

NPS	Class
3/4 in.	800
1 1/2 in.	800
3/4 in.	1500
1 1/2 in.	1500

Table B.2—Size and Class to be Tested for Each Globe Valve Made in Accordance with API 602

NPS	Class
3/4 in.	800
1 1/2 in.	800
3/4 in.	1500
1 1/2 in.	1500

Table B.3—Size and Class to be Tested for Each Gate Valve Made in Accordance with API 600

NPS	Class
4 in.	150
4 in.	600
4 in.	1500
12 in.	150
12 in.	600
12 in.	1500
20 in.	150
20 in.	600

Table B.4—Size and Class to be Tested for Each Gate Valve Made in Accordance with API 603

NPS	Class
3/4 in.	150
1 1/2 in.	600
4 in.	150
4 in.	600
12 in.	150
12 in.	600
20 in.	150
20 in.	600

Table B.5—Size and Class to be Tested for Each Globe Valve Made in Accordance with API 623

NPS	Class
4 in.	150
4 in.	600
4 in.	1500
12 in.	150
12 in.	600
12 in.	1500

### API 600, 602, 603 & 623 – GATE & GLOBE VALVES

SPONSORED BY:





## VALVES – Fugitive Emissions Testing Standards

### API 641 – Type Testing of Quarter-turn Valves for Fugitive Emissions **VALVES TESTING GROUPS A-F**

#### Annex C (informative)

#### Valve Groups Flowchart

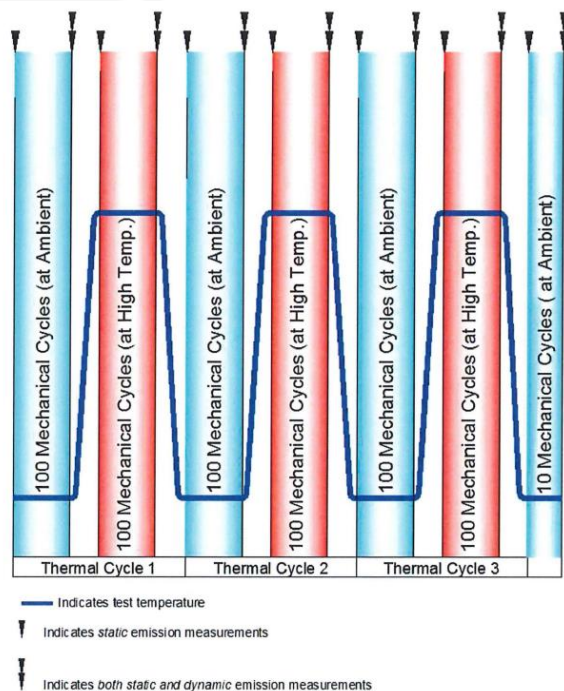


Figure 1—Valve Cycling

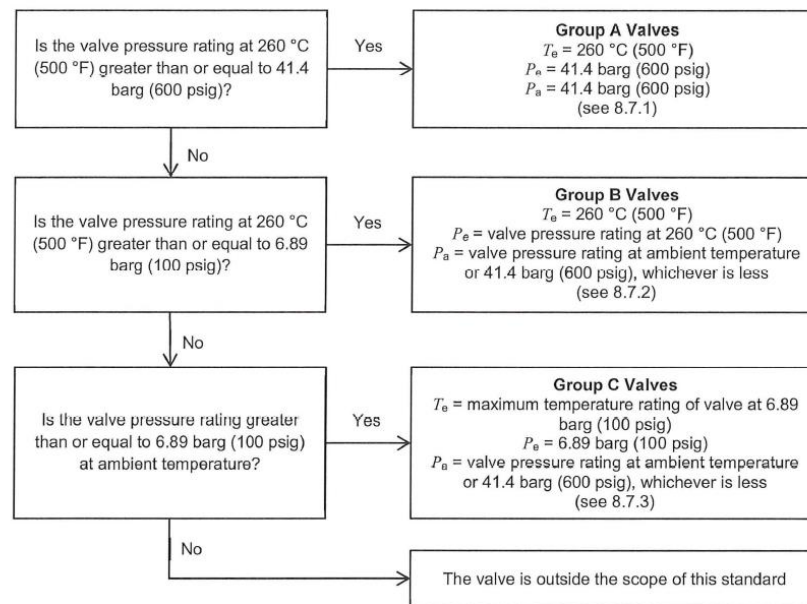


Figure C.1—Test Temperature and Pressure: Valve Temperature Rating  $\geq 260\text{ °C (500 °F)}$

14

API STANDARD 641

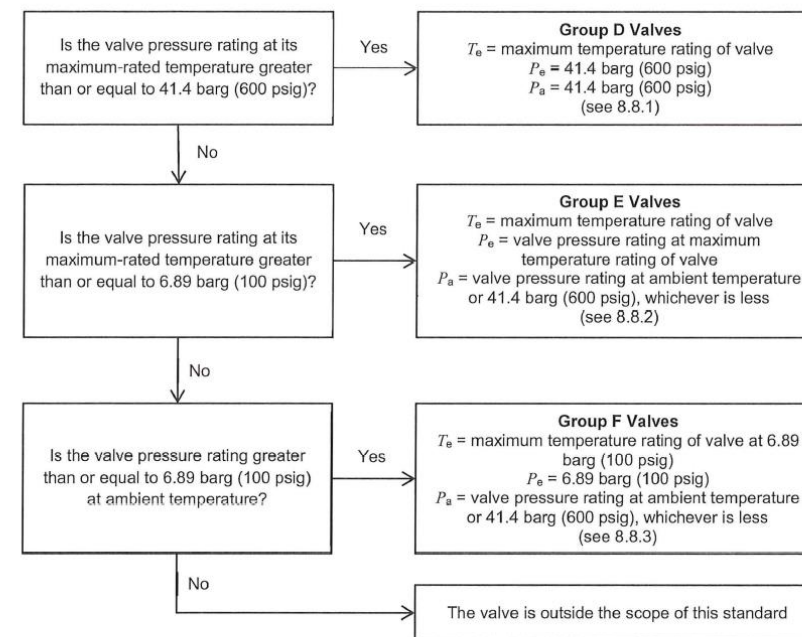


Figure C.2—Test Temperature and Pressure: Valve Temperature Rating  $< 260\text{ °C (500 °F)}$

API 599, 608 & 609 – PLUG, BALL & BUTTERFLY VALVES THERE ARE 6 DIFFERENT TEST GROUPS BASED ON PRESSURE/TEMPERATURE RATINGS

SPONSORED BY:



**Bray**

**EMERSON**

**MRC Global**

**TEADIT**  
Sealing for a Safer and Greener Tomorrow

**ZWICK**  
ARMATUREN GMBH

## VALVES – Fugitive Emissions Testing Standards

ISO 15848-1:2015(E)

### ISO 15848-1 – Industrial valves — Measurement, test and qualification procedures for fugitive emissions —

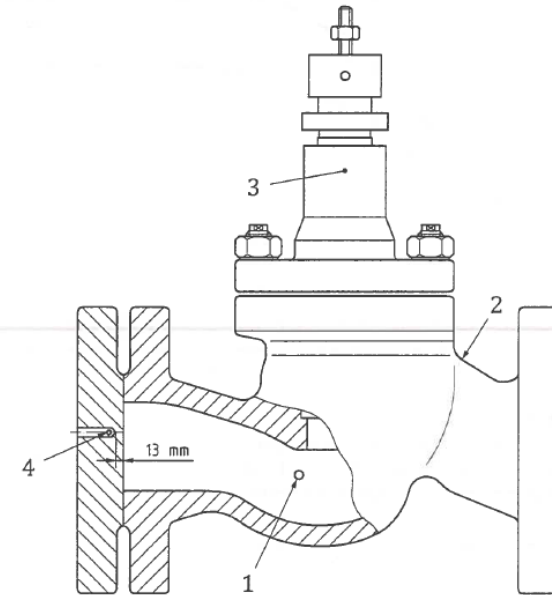
Part 1:

### Classification system and qualification procedures for type testing of valves

\*ISO is working on a packing test standard like API 622

All temperatures at location 1, 2, and 3 (and 4) shall be stabilized before leakage is measured (see Figures 2 and 3). Temperature at location 3 shall be stabilized for minimum 10 min prior to leakage measurement.

Check if the temperature variation is within  $\pm 5\%$ .



**Key**

- 1 location 1: flow path (temperature  $T_1$ )
- 2 location 2: valve body (temperature  $T_2$ )
- 3 location 3: stuffing box (temperature  $T_3$ )
- 4 location 4: optional for flow path (temperature  $T_1$ )

Figure 1 — Measurements of temperature

SPONSORED BY:



**Bray**



**MRC Global**



**ZWICK**  
ARMATUREN GMBH

## VALVES – Fugitive Emissions Testing Standards

2022

### ISO 15848-1 – Industrial valves — Measurement, test and qualification procedures for fugitive emissions —

Part 1:

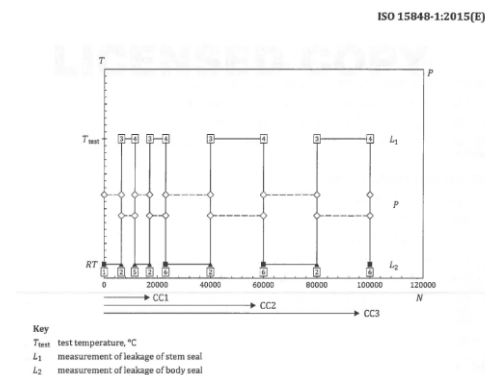
### Classification system and qualification procedures for type testing of valves

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

Class	Measured leak rate (mass flow)	Measured leak rate (mass flow)	Measured leak rate (volumic flow)	Remarks
	mg·s <sup>-1</sup> ·m <sup>-1</sup> stem perimeter (for information)	mg·s <sup>-1</sup> ·mm <sup>-1</sup> stem diameter through stem seal system	mbar·l·s <sup>-1</sup> per mm stem diameter through stem seal system	
AH <sup>a</sup>	≤10 <sup>-5</sup>	≤3,14·10 <sup>-8</sup>	≤1,78·10 <sup>-7</sup>	Typically achieved with bellow seals or equivalent stem (shaft) sealing system for quarter turn valves
BH <sup>b</sup>	≤10 <sup>-4</sup>	≤3,14·10 <sup>-7</sup>	≤1,78·10 <sup>-6</sup>	Typically achieved with PTFE based packings or elastomeric seals
CH <sup>b</sup>	≤10 <sup>-2</sup>	≤3,14·10 <sup>-5</sup>	≤1,78·10 <sup>-4</sup>	Typically achieved with flexible graphite based packings

<sup>a</sup> Measured by the vacuum method as defined in Annex A.

<sup>b</sup> Measured by the total leak rate measurement method (vacuum or bagging) as defined in Annex A.



ISO 15848-1:2015(E)

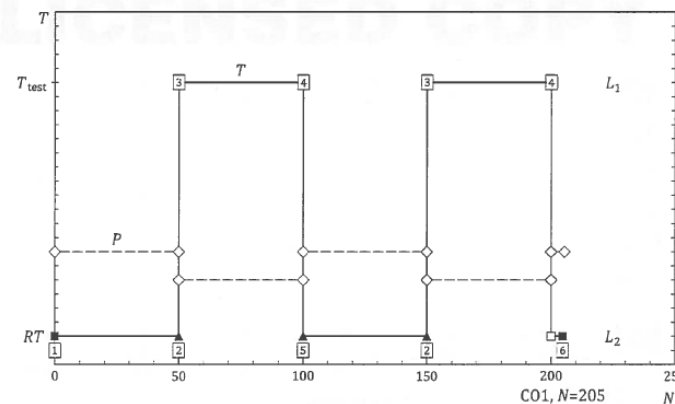


Figure 4 — Mechanical-cycle classes for isolating valves (endurance Class C01)

Mechanical & Thermal 100 cycles, 50 cycles room and 50 cycles 260°C(500°F)/400°C(752° F) temperatures for C01=205 cycles & final 5 cycles room temperature at temperature rated pressure – 1 PACKING ADJUSTMENT ALLOWED & MAXIMUM LEAKAGE

Testing With Helium or Methane

SPONSORED BY:



**Bray**



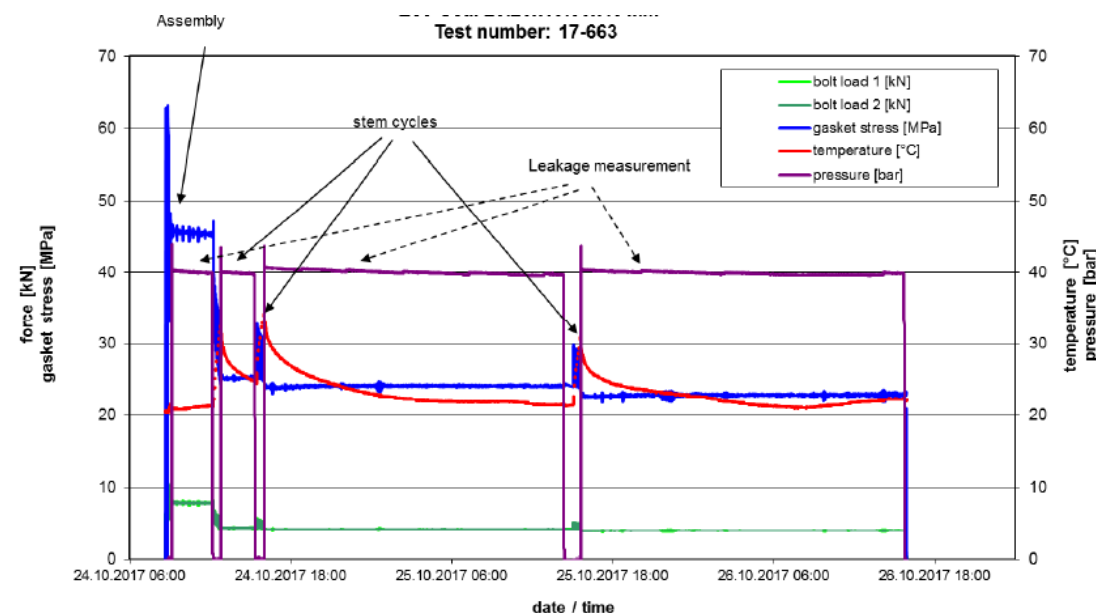
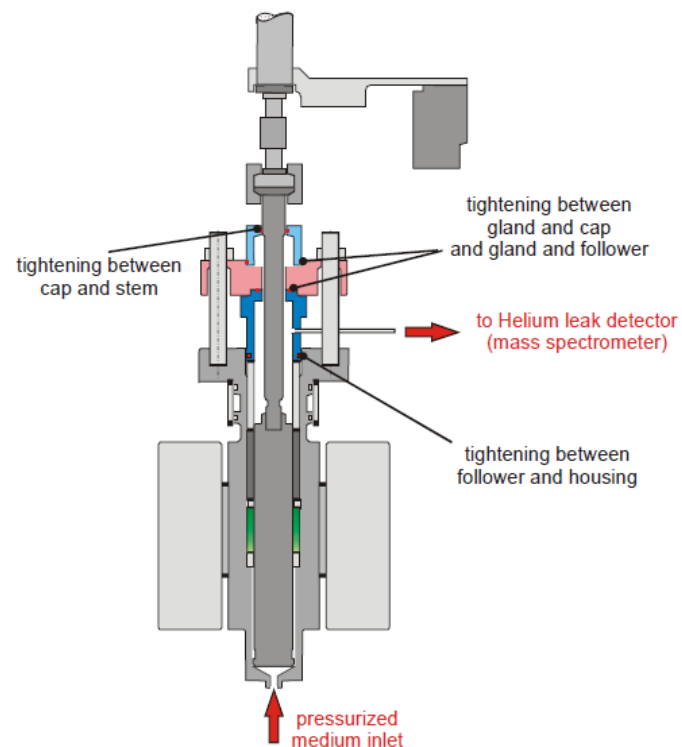
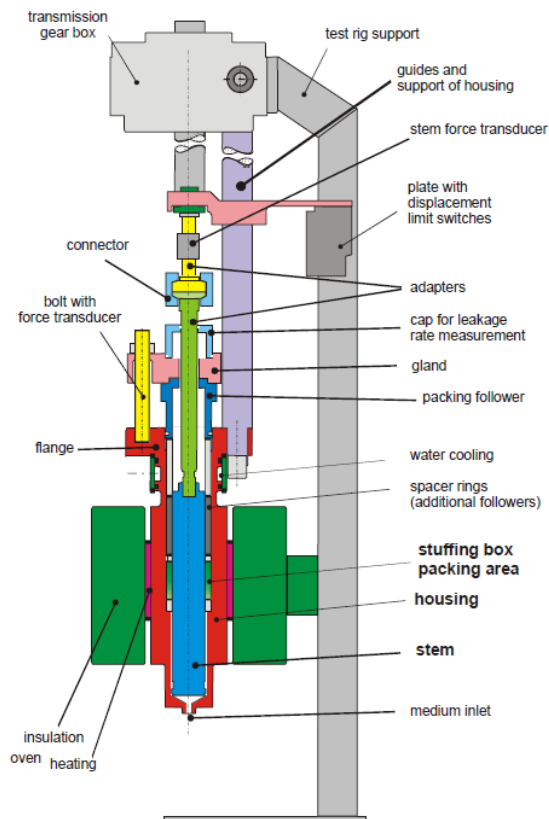
**MRC Global**



**ZWICK**  
ARMATUREN GMBH

## VALVES – Fugitive Emissions Testing Standards

### TALuft VDI 2440 – Emission control Mineral oil refineries



**Mechanical 100 cycles and 100 cycles room temperature for 200 cycles at 40 bar(580psig) – NO PACKING ADJUSTMENT ALLOWED & MAXIMUM LEAKAGE**



# VALVES – Standards (Fugitive Emissions Required)

## API 622 – API 624 – ISO 15848-1 – TALuft VDI

Standard	API 622	API 624	ISO 15848-1	TALuft
Type	Packing	Valve	Valve	Packing
Packing	Graphitic	API 622		
# Cycles	1510	310	C1 = 205	200
# Thermal	5	3	2	1
Temperature	500°F	500°F	392°F/752°F	68°F/482°F
Leakage Maximum	100ppm	100ppm	$\leq 1.78 \times 10^{-6} \text{ mbarl/sm}$ (per mm stem diameter)	$\leq 1.0 \times 10^{-4} \text{ mbarl/sm}$
	300°F			
Packing Materials Testing	Weight Loss 1100°F			
	Density			
	Lubricant Content			



## VALVES – Standards (Fugitive Emissions Required)

### API 599 – Metal Plug Valves - Flanged, Threaded, and Welding Ends, Eighth Edition

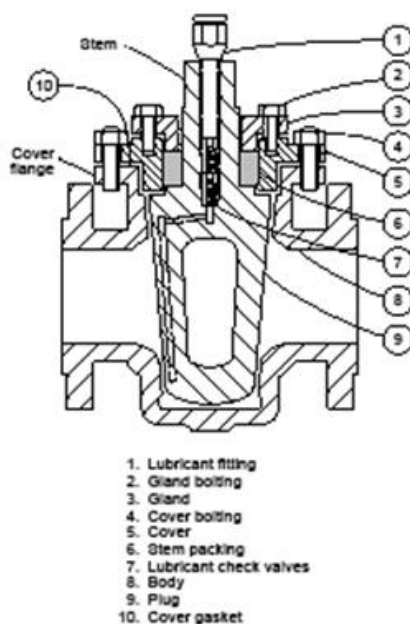


Figure 1—Parts Identification for Lubricated Plug Valve

SPONSORED BY:



Bray



MRC Global



ZWICK  
ARMATUREN GMBH

## VALVES – Standards (Fugitive Emissions Required)

### API 600 – Steel Gate Valves-Flanged and Butt-welding Ends, Bolted Bonnets

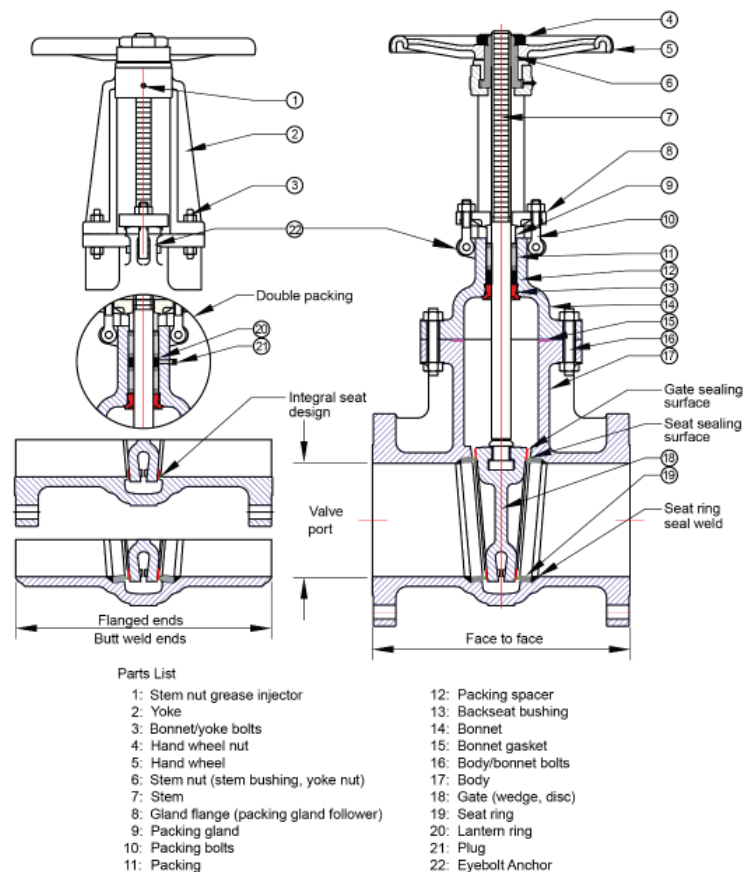


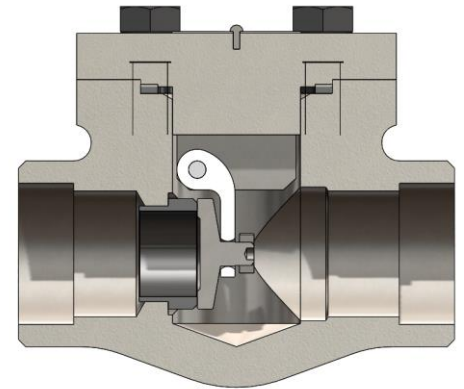
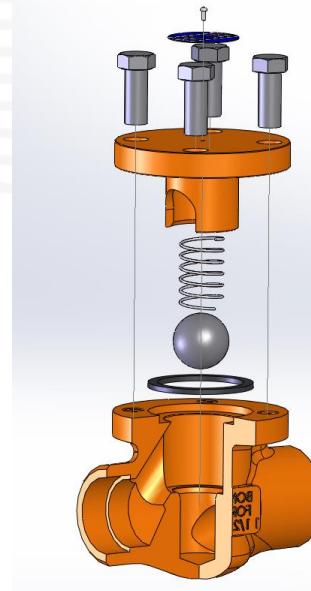
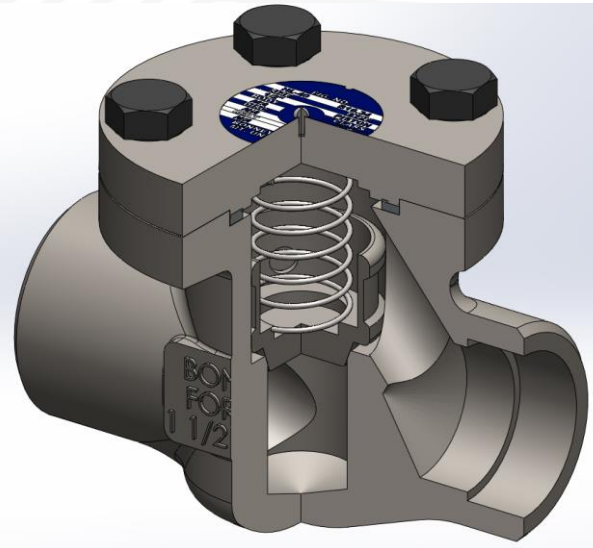
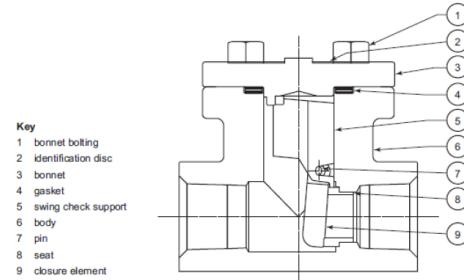
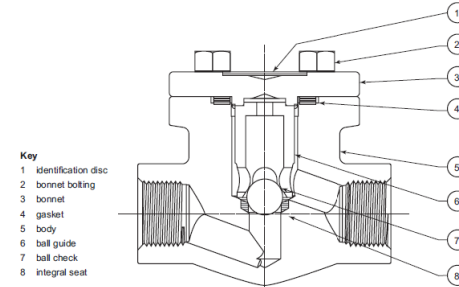
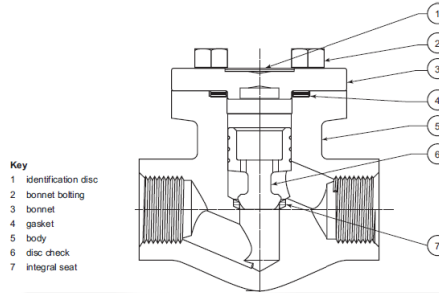
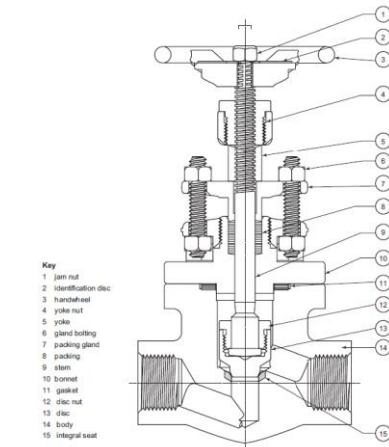
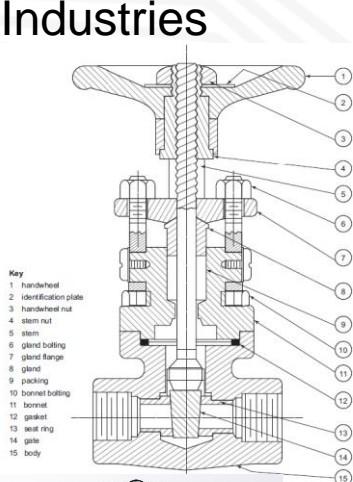
Figure C.1—Valve Nomenclature



## VALVES – Standards (Fugitive Emissions Required)

2022

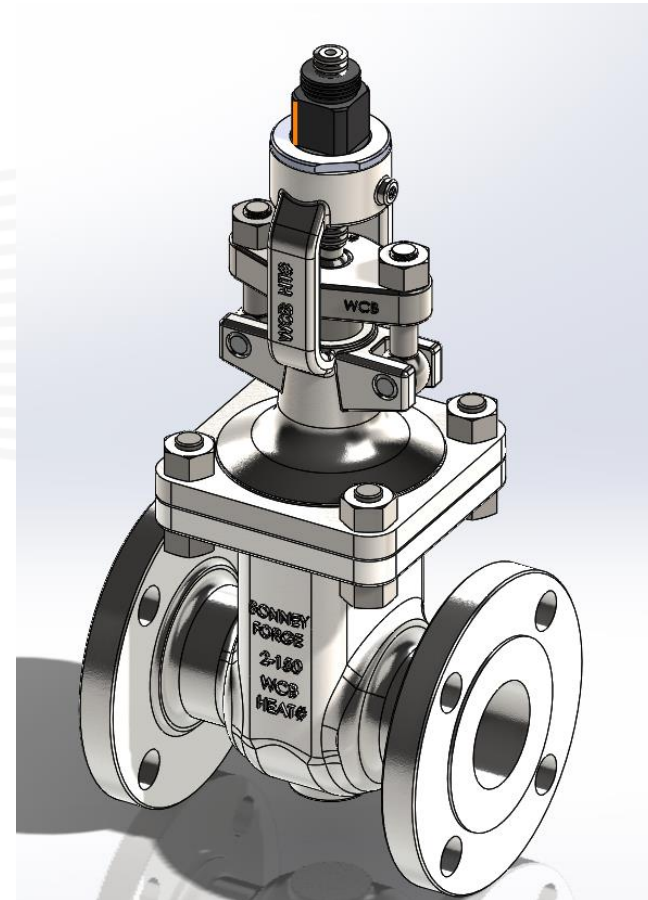
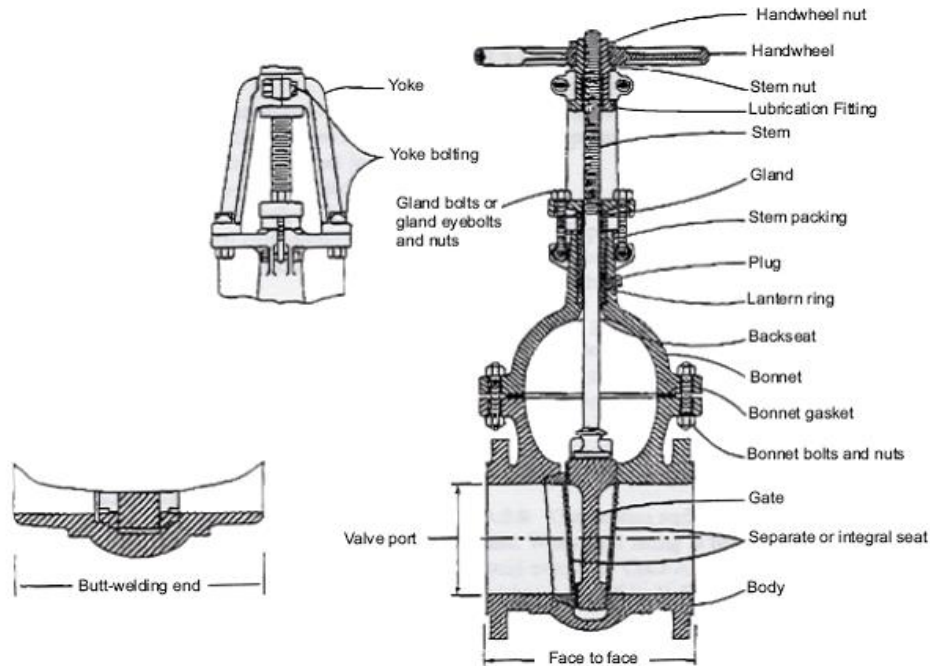
**API 602 – Gate, Globe, and Check Valves for  
Sizes DN 100 (NPS 4) and Smaller for  
the Petroleum and Natural Gas  
Industries**





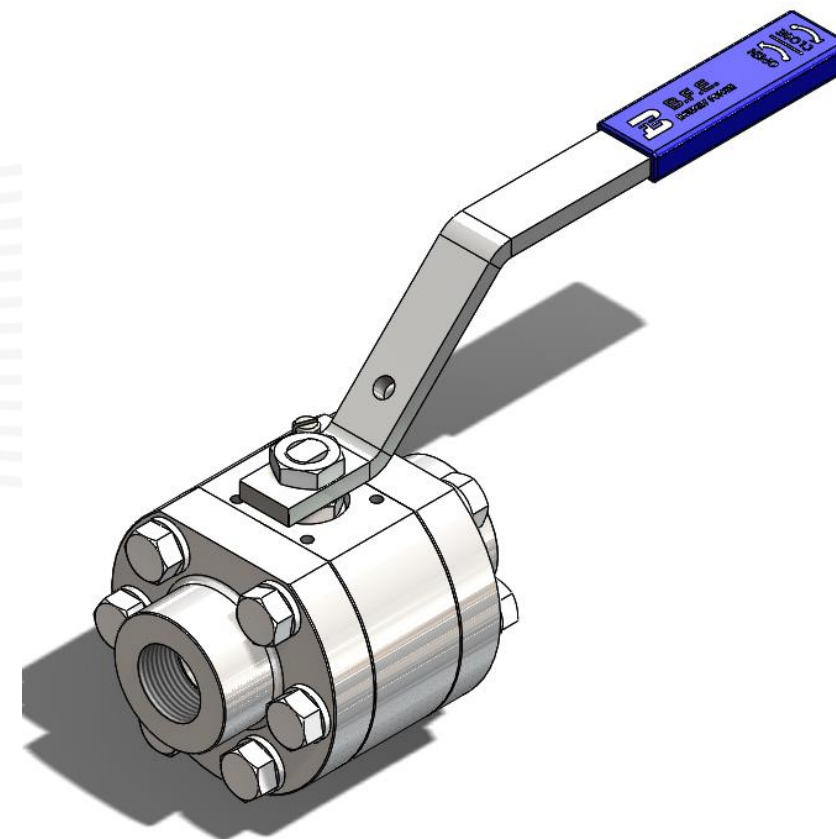
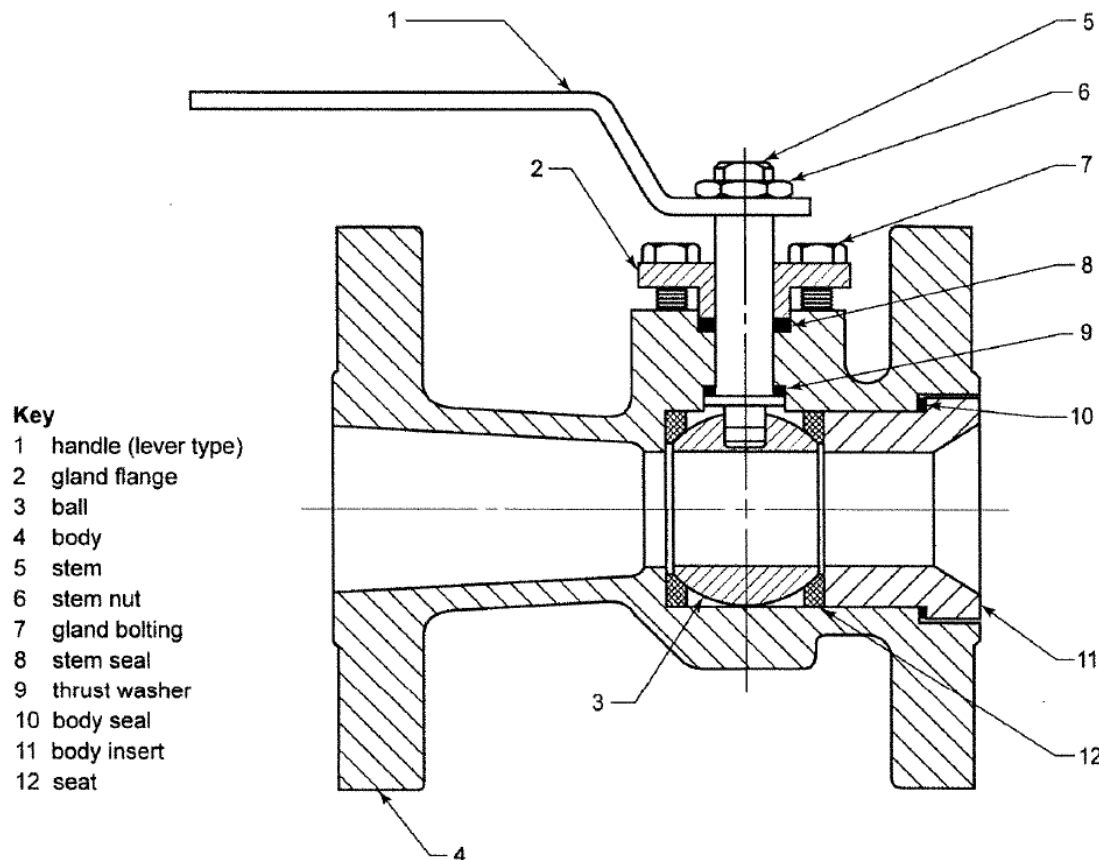
## VALVES – Standards (Fugitive Emissions Required)

### API 603 – Corrosion-resistant, Bolted Bonnet Gate Valves-Flanged and Butt-welding Ends



## VALVES – Standards (Fugitive Emissions Required)

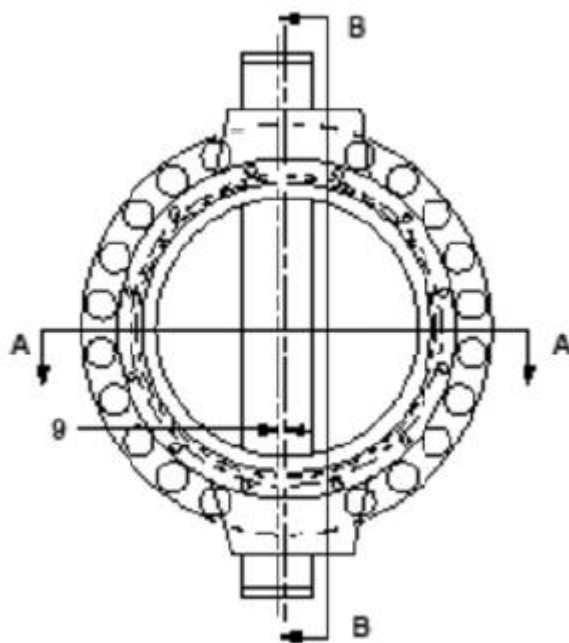
### API 608 – Metal Ball Valves-Flanged, Threaded, and Welding Ends





## VALVES – Standards (Fugitive Emissions Required)

API 609 – Butterfly Valves: Double-flanged, Lug- and Wafer-type



SPONSORED BY:



Bray

EMERSON

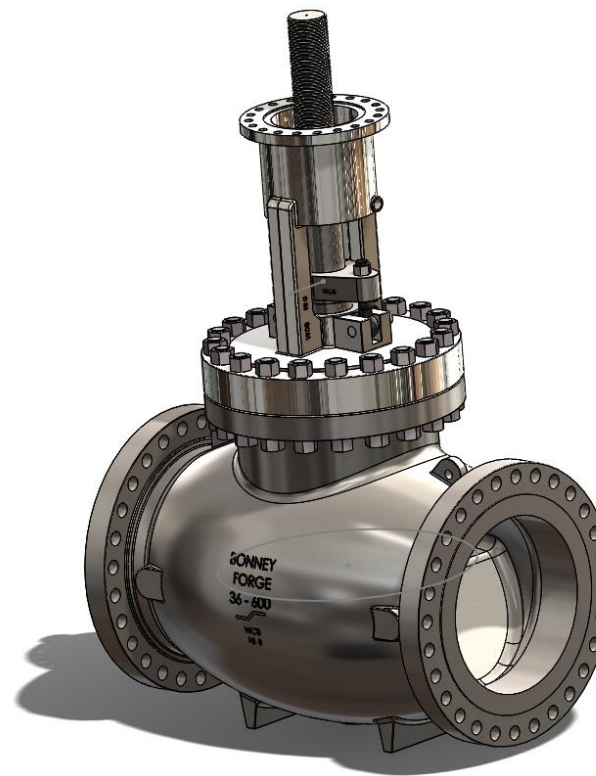
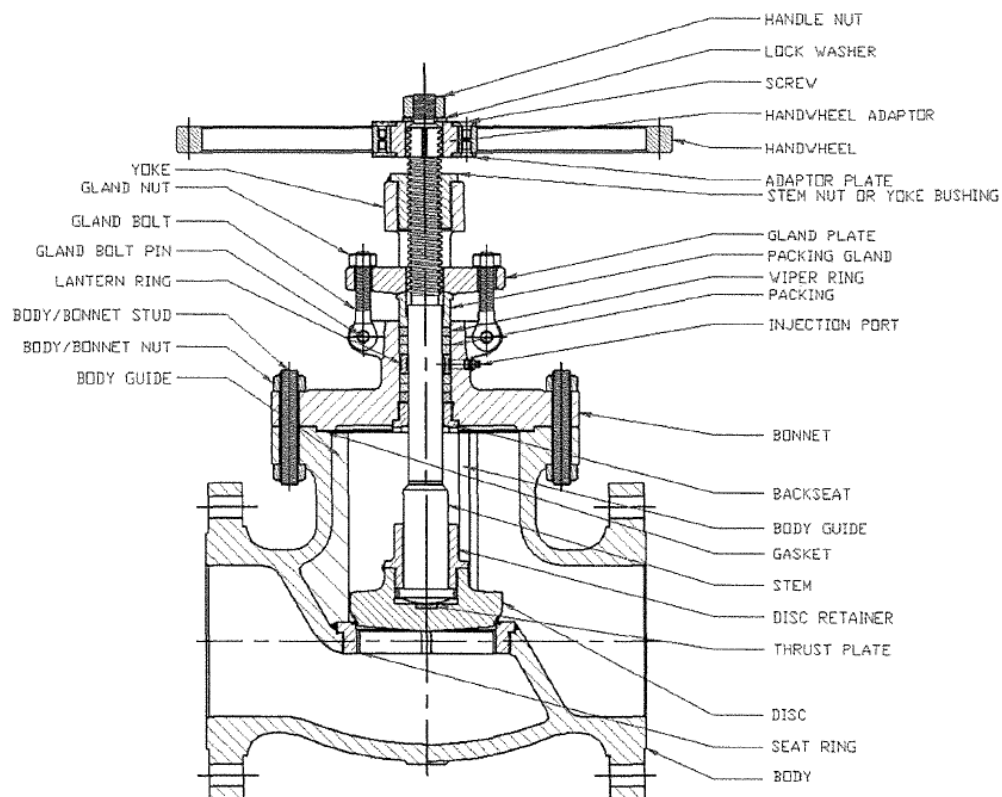
MRC Global

TEADIT  
Sealing for a Safer and Greener Tomorrow

ZWICK  
ARMATUREN GMBH

## VALVES – Standards (Fugitive Emissions Required)

### API 623 – Steel Globe Valves-Flanged and Butt-welding Ends, Bolted Bonnets



## VALVES – OTHER Standards Testing & Valves/Packing

**API 598** – Valve Inspection and Testing

**API 607** – Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats

**API 594** – Check Valves: Flanged, Lug, Wafer, And Butt-welding

**API RP 621** – Reconditioning of Metallic Gate, Globe, and Check Valves

**MSS SP 120** – Flexible Graphite Packing Sealing For Rising Stem Valves

**MSS SP 121** – Qualification Testing Methods for Stem Packing for Rising Stem Steel Valves

SPONSORED BY:



## PACKING – OTHER Standards

**DIN EN 16752** – Specification for a Test Procedure  
For Packings for Rotary Applications

**ASTM F2087** – Standard Specification for  
Packing, Fiberglass, Braided, Rope and Wick

**ASTM F2168** – Standard Specification for  
Packing Material, Graphitic, Corrugated Ribbon  
Or Textured Tape, and Die-Formed Ring

SPONSORED BY:



## Fugitive Emissions Present Day

Demand for Low Emissions Valves Followed Available Testing & Mandatory Requirements in Valve Standards Years Later

Manufacturing Low Emissions Valves Is the Standard Included in Valve Standards API 599, 600, 602, 603, 608, 609 & 623

Valve Manufacturers Low Emissions Valves Testing Certified Continues To Vary Globally

Low Emissions Valves Have Been Available Although Some Valve Manufacturers Only More Recently

### **Fugitive Emissions Testing & Valve Standards:**

**As more data becomes available fugitive emissions testing & valve standards continue changing**

**Changes are happening now in industry committees**

**Improvements will continue to enhance the clarity to further reduce testing requirements confusion**

SPONSORED BY:





# MAINTAINING “Certified Low Leak Technology” – **CLLT**



Subject: 5 Year Statement for Bonney Forge Low E (Low Emissions) Valves  
Distribution: Bonney Forge; Customers

Bonney Forge Low E (Low Emission) Forged and Cast Steel Valves have been designed and tested for 5 year certified Low E fugitive emissions service. These valves are identified as Low E “Low Emissions” and “Certified Low Leaking Technology” (CLLT).

Bonney Forge Low E Forged and Cast Steel Valves have completed API 622 Second Edition fugitive emissions 3<sup>rd</sup> party testing (1,510 mechanical cycles & 5 thermal cycles) with performance of less than 50 ppm without packing adjustment/re-torque during testing.

Bonney Forge Low E Forged and Cast Valves have completed API 624 First Edition fugitive emissions 3<sup>rd</sup> party testing (310 mechanical cycles & 3 thermal cycles) with performance of less than 50 ppm without packing adjustment/re-torque during testing.

Bonney Forge Low E Forged and Cast Steel Valves manufactured by Bonney Forge are “Low-E” Valve Technology exceeding industry standard requirements as follows.

- 100 ppmv Maximum Fugitive Emission Leakage
- Qualified Third Party Testing
- Testing Continuously Performed

Per EPA Method 21 and “tested” pursuant to “generally-accepted good engineering practices”.

www.bonneyforge.com  
800.345.7546  
814.542.2545  
814.542.9977 fax  
14496 Croghan Pike  
Mount Union, PA 17066

**RRC Valve**



Bonney Forge recommends the following conditions of valve use to ensure Low E performance throughout the service life:

1. Store the valve in accordance with Bonney Forge Installation, Operation, and Maintenance (IOM) manual.
2. Follow all instructions as written within the supplied Bonney Forge valve shipping tags and/or Bonney Forge IOM manual and fit for service.
3. Perform inspection of the valve for visible damage.
4. Keep the valve stem free of scratches or corrosion.
5. Protect and handle the valves properly during plant construction and transportation. This includes the protection of exposed stems and the glands of valves when painting and sandblasting.
6. Verify the packing gland torque in accordance with the supplied Bonney Forge shipping tags or Bonney Forge IOM manual to maintain valve performance and reduce potential leaks above allowable limits.
7. Inspect the valves for service requirements annually at a minimum and verify the packing gland torque in accordance Bonney Forge IOM manual to maintain valve performance and reduce potential leaks above allowable limits.
8. If leakage is detected to be 100 ppm above background the first repair attempt must be done in accordance with 40CFR60.482-7 and/or 40CFR60.482-7a to ensure the torque is at the recommended value as stated within the Bonney Forge IOM manual.
9. Bonney Forge valves that have been drilled and tapped to reduce or eliminate leakage will void any and all claims represented here or within any other Bonney Forge related literature, documents, correspondence, etc.

Sincerely,

*Paul Heald*

Paul Heald  
Vice President of Product Engineering  
[pheald@bonneyforge.com](mailto:pheald@bonneyforge.com)  
800-345-7546  
d 281-765-3386  
c 832-361-9681

www.bonneyforge.com  
800.345.7546  
814.542.2545  
814.542.9977 fax  
14496 Croghan Pike  
Mount Union, PA 17066

**RRC Valve**



SPONSORED BY:



**EMERSON**



**MRC Global**



# MAINTAINING “Certified Low Leak Technology” – **CLLT**



## Appendix 1 – Low Emission Valve Identification

### Forged LE Valve Marking

**Figure Number –**  
Indicates “LE” for low  
emission API 624 &  
Bonney Forge Eco-  
Seal® Packing



### Cast LE Valve Marking



**Riveted Tag –** low  
emission API 624 &  
Bonney Forge Eco-  
Seal® Packing



### Cast LE Valve Marking

BONNEY FORGE FIG.	1-12-RF-LE	TYPE	GATE	DATE	CE 0036
B16.34 CLASS	CL150	S/N		API 600/624/B 16.34-NACE	
SIZE 8" DN200	BODY SA WCB	STEM	13CR	285	PSI@100° F TM FILE: 20080016
DISC HF	SEAT HF	80	PSI@MAX T	285	PSI@MINT

**Riveted Tag –**  
Includes API 624



www.bonneyforge.com  
800.345.7546  
814.542.2545  
814.542.9977 fax  
14496 Croghan Pike  
Mount Union, PA 17066

**RRC Valve**



www.bonneyforge.com  
800.345.7546  
814.542.2545  
814.542.9977 fax  
14496 Croghan Pike  
Mount Union, PA 17066

**RRC Valve**



SPONSORED BY:



# MAINTAINING “Certified Low Leak Technology” – CLLT



Forged LE Valve Marking



Hand Wheel  
Tag - Includes  
API 624

www.bonneyforge.com  
800.345.7546  
814.542.2545  
814.542.9977 fax  
14406 Croghan Pike  
Mount Union, PA 17066

RBC Valve



SPONSORED BY:

