Fugitive Emissions Standards & Laboratory Test Methods for Valves

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50 Years in 50 Seconds

1964 Houston air pollution

Measuring air pollution in 1974
50 Years in 50 Seconds

“The air is greener in Pasadena”
50 Years in 50 Seconds

Not anymore!

Thanks to the end-users, valve manufacturers, valve service companies, leak abatement firms, packing manufacturers and everyone who had a hand in cleaning our air!
The past 20 years

- End-users pushed the valve manufacturers through the API
- Initial tests were based upon Method 21
- First US industry valve test standard was ANSI/ISA SP93.00.01 in 1999
Testing standards

- MSS created a packing test standard in 1997
- First API test standard – API 622, packing test, 2006
- API 624, 2014
- API 641, 2016
- ISO 15848-1, 2006

First United Valve FE test- 2001
What Makes a Valve Low-emissions capable?

- FE containment Packing
- Little or no stem run-out
- Correct stem & stuffing box finishes
- Correct dimensions & tolerances of all packing chamber components
- Proper torque on packing
Dimensions & tolerances are critical for FE containment

- **Packing gland**
  1) ID
  2) OD

- **Packing**
  1) ID
  2) OD
  3) For API, Must be RP622

- **Bonnet**
  1) ID
  2) OD
  3) Finish

- **Stem**
  1) Diameter
  2) Straightness
  3) Runout
  4) Finish
  5) Cylindricity
Why We Test

- Repeatability is still a major issue in low-cost manufacturing countries
- Legacy designs do not address the dimensions and tolerances needed for Low-E packing efficacy
- Some manufacturers still don’t know how to achieve repeatable Low-E compliance
Common Valve Test Standards

- **API 624**, “Type Testing of Rising Stem Valves Equipped With Graphite Packing for Fugitive Emissions”
- **API 641**, “Type Testing of Quarter-turn Valves for Fugitive Emissions”
- **ISO 15848-1**, “Industrial Valves- Measurement, test, qualification procedures for fugitive emissions” (type testing)
- End-user “type testing”
API 624 – for Multi-turn valves

- Next edition (2nd) due out in 2018
- 3 thermal cycles @ 500° F
- 310 Mechanical cycles
- Both static and dynamic leakage measurements
- Gasket leakage above 50 ppm cause for rejection
- Maximum test pressure 600 psig
- Required by API 600, API 602, API 603, API 623 & RP591
API 624 – for Multi-turn valves

Testing a 20” class 900 gate valve
Typical API 624 set-ups
Test software GUI interface
API 641 – for Quarter-turn valves

• First edition 2016
• 3 thermal cycles
• 610 Mechanical cycles
• Both static and dynamic measurements
• Multiple categories or “groups”
• Maximum test pressure 600 psig
• Not yet required by API ¼ turn design standards API 599, API 608, API 609
API 641 – for Quarter-turn valves

Testing ball valves to API 641
ISO 15848-1

- “Cafeteria” style multiple classifications
  - Tightness classes
  - Endurance classes
  - Temperature classes
- Primarily a helium procedure, but methane is allowed
- Very popular for valves to be used in the EU and China
- Used for valves that don’t fall under API standards & testing criteria
- Used for control valves because of high number of cycles
- ISO 15848-2 is a production test for valves originally qualified to 15848-1
Cryogenic FE testing
Failure Modes

• Catastrophic bushing failure
  - Galling & lock-up
  - Total removal of threads because of poorly machined components

• Stem scoring due to poorly machined or out-of-tolerance parts

• Gross gasket leakage

• Lubricant dripping down from bushing

• Gross packing leakage due to poor dimensions or tolerances
Bushing Failure

Original bushing

After threads gouged out
Dripping lubricant

Not an issue when valves were tested in the stem horizontal position
Dimensions & tolerances are extremely important.
Large linear valve issues

- Stem & flow horizontal – not good
- Potential for substantial FE leakage
- Side-loading of packing
- API 624 requires a stem vertical test
API 624 – large valves

Component misalignment causes leaks

- Yoke bushing or actuator mount
- Yoke
- Stuffing box
- Backseat bushing
- Disc to stem alignment
- Body & disc guides
Stem Horizontal Issue

This side of packing can be over-compressed

Gravity
API 624 – large valves in horizontal service

Cumulative errors in dimensions & tolerances are can cause catastrophic packing failures
Horizontal issues (cont.)

What about low emissions valves in horizontal orientations? Some Suggestions:

- Total misalignment of stem should be less than 0.020” for most low E packings to work.
- Double check all dimensions and relational parts geometry
- Assemble or actuate the valve in the stem vertical position
- Confirm damage free movement of stem (cycle open and close)
- Optional: Perform an EPA method 21 type test- a low pressure gas test looking for bubbles at the packing area
A word about testing facilities

- All testing facilities are not created equal
- It is not just equipment and technicians
- Engineering experience and real-world valve expertise are very important
- End-user concern if “low-cost-country” testing is allowed
IMHO & Looking into the crystal ball

- Helium will replace methane as the test gas
- API will create a full-featured type test standard that will include high temperature FE testing at working pressures
- API will create a helium production test standard
Questions?

The ultimate in leaky valve containment!