

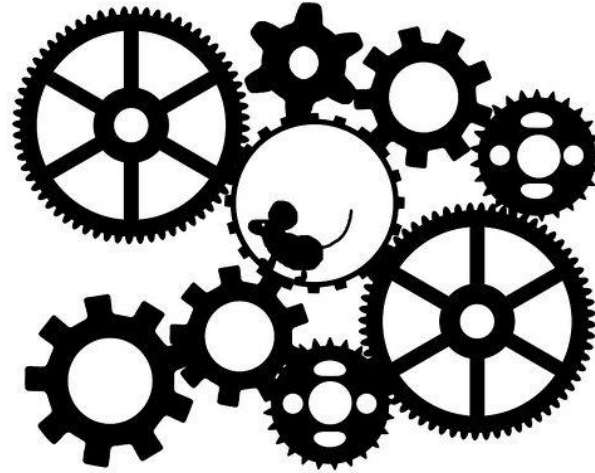
Valve Qualification Standards and Specifications

Presented by Alberto Daglio



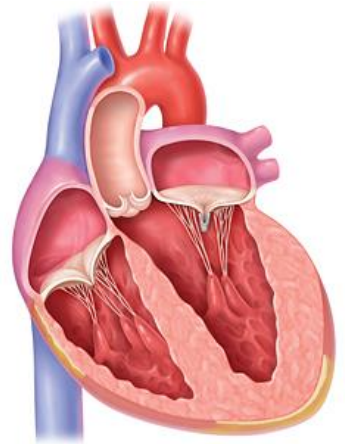
- **Introduction - valve functions and failures**
- **Regulations Codes and Specifications**
- **Qualification programs**
- **Sampling and qualification ranges**
- **The future and one unique spec**

Valve function and Failures

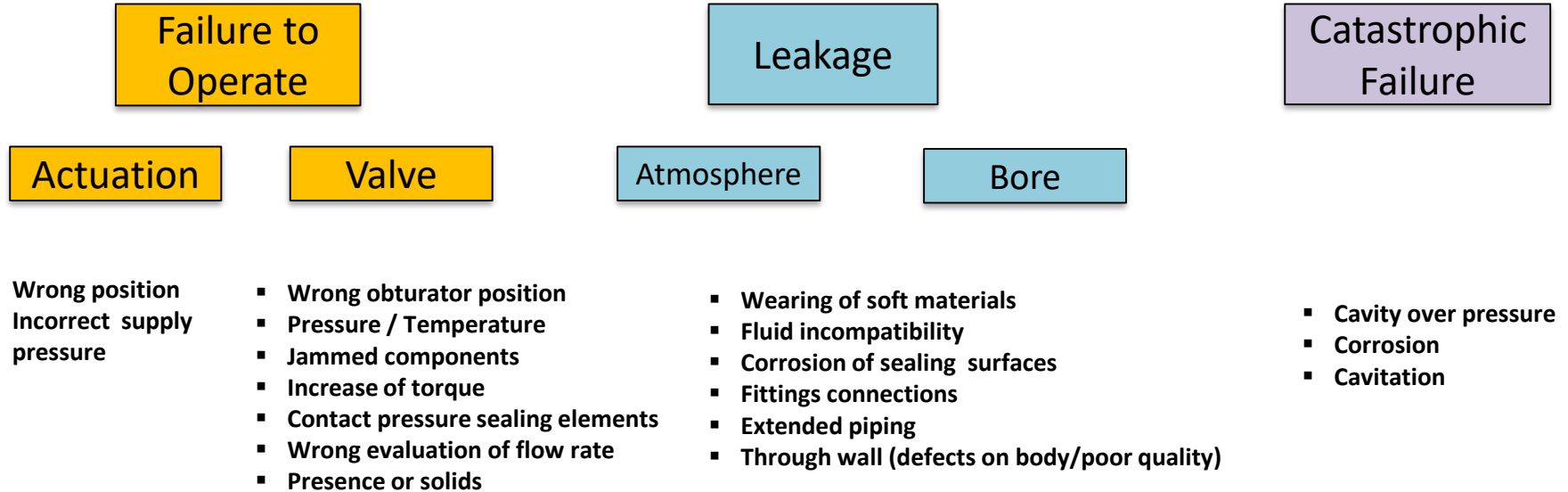


Valves are becoming more critical....devices

- Increase of Pressures and Temperatures
- Unconventional and extreme environmental conditions
- Presence of unwanted service constituents (H₂S, CO₂, solids)
- Chemical injection (Methanol, corrosion inhibitors)
- Ambitious leakage rates required by Customers (Gas near-zero leakage)



Valve Function - Failures modes

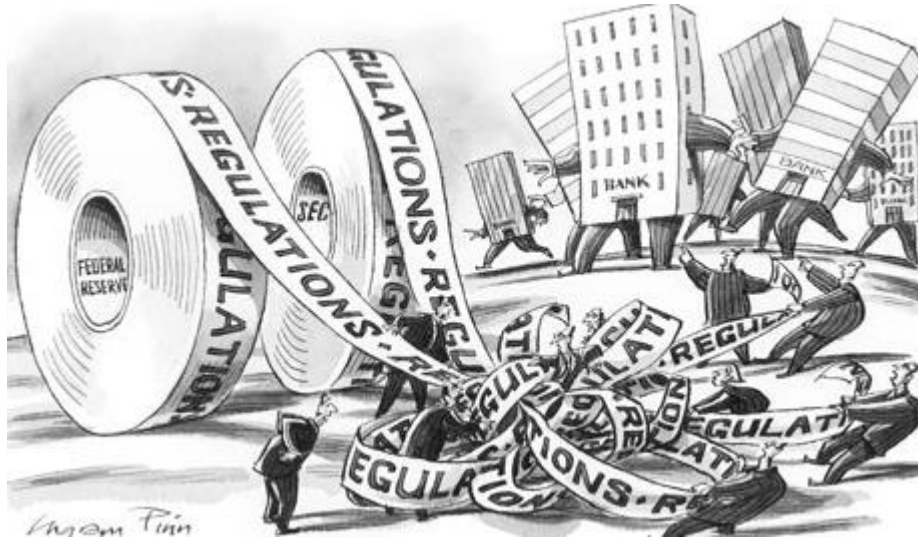


These can all lead to

Increase of **P**robability of **F**ailure on **D**emand (**PFD**) (minimize it!)

Reduction of **M**ean **T**ime **B**etween **F**ailures (**MTBF**) (maximize it!)

Regulations Codes and Specifications



Definitions

EN 736 - Part 3

Type Test: carried out on one or more valves representative of the design and the manufacturing process to confirm conformance of the production with specified requirements

Production Test: carried out on valves during the manufacturing process to confirm conformance of the production with the specified requirements

Acceptance Test: carried out in accordance with the technical specifications of the order

Qualification “Standards”

The product must pass performance tests and quality assurance tests and meet criteria stipulated in contracts regulations or specifications.

Regulations (Law of the Land)



Codes



AMERICAN PETROLEUM INSTITUTE



American National Standards Institute



Specifications



International Association of Oil & Gas Producers

Qualification programs: common goals

- Confirm ability to seal against through leakage over a given number of cycles
- Confirm seals perform at maximum and minimum temperatures
- Validate valve operating torque/thrust at ambient, maximum and minimum temp
- Determine fugitive emission performance at ambient, max. and min. temp
- Prove environmental containment
- Prove robustness/stability of metallic trims
- Prove soft seal combinations

Laws of the Land



Laws of the Land: by default compliance is required



EPA regulations 40 CFR part 60

New fugitive emission regulations sub-part OOOOa for methane

New, modified and reconstructed installation must be checked every 6 months.

Release of Methane must be below 500 ppm.

(Only country in the World – as far as I know- that regulates Methane release)

BSEE Bureau of Safety and Environmental Enforcement (“Bessie”)

Subsea valves and Boarding valves must be API17D/6A monogrammed PR2 / 6AV1 (sand)

USCG United States Coast Guard (Military)

Valve must be Fire Tested to API 607 (and not 6FA that is devoted to 6D/6A)

Laws of the Land: by default compliance is required



If a pressure vessel is installed in Australia it must be reviewed and certified by an Australian third party for compliance with AS 1210, after it's imported in Australia must be re-hydro tested in the presence of a local accredited inspector. Design rules are same as ASME



CE Mark for top side valves (PED + ATEX +...)

The PED provides a series of Essential Safety Requirements that must be met and a series of modules that define the standard of inspection and third party involvement, moreover it may require manufacturer certification (H1)

ATEX Certified equipment is designed to prevent the generation of ignition sources such as: Electric sparks, electrostatic discharges, electromagnetic waves, mechanically generated sparks.

Laws of the Land: by default compliance is required



ABNT NBR 15927

Calls for ASME, API and ISO 10497 (fire test), has a detailed design verification and detailed prototype testing.

Performance test should be conducted by performing cycles of opening and closing the valve on the prototype

The opening and closing cycles should be monitored by torque sensors

In addition a complete study on design calculations and stress analysis, criteria used for selecting materials.

Laws of the Land: by default compliance is required



ABNT NBR 15927

Some prototypes can be re used

On Ball valve a sort of “stall” test is required

| Nominal Diameter (ND) | Estimated service life of 20 years | | Cycling | | | | Seal Test | Performance (Signature) | Number of Cycles applied at maximum operating torque (MOT) |
|----------------------------|------------------------------------|---------|---|----------------------------|-----------------|---------------------------------------|--|-------------------------|--|
| | Number of Cycles | | Prototype quantity and number of cycles | | | Reliability (10 years of useful life) | | | |
| | Minimum | Maximum | Prototype (min, quantity) | Minimum cycle by prototype | Total of cycles | | | | |
| 15 to 40 (1/2 to 1 1/2) | 500 | 5000 | 5 | 1000 | 10000 | 98% | See Table 8 6 signatures at low pressure and 6 Signatures at high pressure shall be performed. At the beginning and end of the cycling, 6 signatures at medium pressure shall also be collected. | 50 | |
| 50 to 150 (2 to 6) | 100 | 200 | 2 | 500 | 2000 | 98% | | 50 | |
| 200 to 300 (8 to 12) | 50 | 100 | 1 | 250 | 1000 | 98% | | 30 | |
| 350 to 600 (14 to 24) | 50 | 100 | 1 | 250 | 500 | 95% | | 20 | |
| > 600 (>24) | 50 | 100 | 1 | 250 | 500 | 95% | | 10 | |

Laws of the Land: by default compliance is required



Most of machinery and industrial equipment, is to be compulsorily certified before being sold in Russia and in the EAC Eurasian Customs Union, they are generally subjected to **EAC declaration of conformity** regime.

Generally, such a declaration is issued according to the technical regulations called TC CU (this replaces the Gost-R system)

As an example **TR CU 012/2011** is the EAC certificate, comparable to European **ATEX**.

Functional Tests



API 6D: *“Specification for Pipeline and Piping Valves - 24th Edition” (Aug 2014)*

Annex H/I/J - Supplementary tests, extended FAT and Quality Levels

API 6A: *“ Specification for Wellhead and Christmas Tree Equipment - 20th Edition” (Oct 2010)*

Validation testing/Performance Requirement PR1 PR2 (Pressure/ Temperature cycles)

- Force measurement open/close
- Dynamic cycling at ambient temperature
- Maximum/minimum temperature cycling
- Pressure/temperature cycles
- Ambient temperature seal test

API 6AV1: *“Specification for Validation of Wellhead Surface Safety Valves and Underwater Safety Valves for Offshore Service ” (Feb 2013)*

Validation classes and sand tests

Functional Tests



API 17D: *“Design and Operation of Subsea Production Systems –Subsea Wellhead and Tree equipment” (Nov 2011)*
Validation testing/Performance Requirement (Pressure/ Temperature/Endurance cycles)

API 591: *“Process Valve Qualification Procedure” (Feb 2014)*
Manufacturer and Product Qualifications – Test at third party facility is mandatory

Fire Test



API 6FA: *“Specification for Fire Testing of Valves” (Sep 2011)*

6D/6A valves exposed to fire. Gives leakage rates

API 607: *“Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats” (June 2016)*

For Soft seated quarter turn valves. Assumed to be more stringent



ISO 10497: *“Testing of valves - Fire type-testing requirements” (June 2016)*

Valve fire test as very similar to API 607

Fugitive Emissions



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API 622: *“Type Testing of Process Valve Packing for Fugitive Emission” (Oct 2011)*

Methane emissions test, corrosion test and material properties

API 624: *“Type Testing of Rising Stem Valves Equipped with Graphite Packing for Fugitive Emissions”*

API 622 Packing certificate is required. 97% Methane, Max Leakage 100 ppmv

API 641: *“Type Testing of Quarter-turn Valves for Fugitive Emissions” (Oct 2016)*

API 622 Packing certificate is required. 97% Methane, Max Leakage 100 ppmv



ISO 15848-1/2: *“Industrial valves - Measurement, test and qualification procedures for fugitive emissions”*

1 is Type Testing, 2 is Production. (97% Helium or 97% Methane)

Define tightness classes depending on type of packing. Measures in flow rate or ppm.

Sniffing Method vs Vacuum method.

End Users



End users specifications



GP 29-01-37 *“Elastomer and Thermoplastic Selection and Qualification Guidelines for Oil and Gas Production”*

Acceptance of any pressure-containing assembly is contingent upon successful testing of that final assembly with the seals that are part of that assembly. This testing must be performed at the rated pressure, as a minimum, while at the extremes of the rated temperatures... This is explained as being a reduced version of the PR2, a Qualification Test Program buried in a Soft material spec. (Sections B-2/3 address that, thermal and pressure cycles are required)

End users specifications



MESC SPE 77-300 *“Procedure and technical specification for design validation testing of industrial valves”*

All valve Manufacturers must pass Shell EVADOC, Technical Audit and **D**esign **V**alidation **T**esting (**DVT**) to be registered on the companies **T**echnically **A**pproved **M**anufacturer’s and **P**roducts List [TAMAP]. (Previously called **T**ype **A**pproval **T**est)

The TAMAP work is coordinated by **Shell Global Solutions** at a global level in order to avoid the need for repeating the work on every valve purchase.

End users specifications



MESC SPE 77-300 *“Procedure and technical specification for design validation testing of industrial valves”*

Minimum DVT requirements for New manufacturers per valve type or manufacturing location:

Design Evaluation to MESC requirements;

Technical Audit and;

At least one valve mid-range size in Class 900 & one in Class 2500 successfully passed DVT testing for each valve type / design to be agreed with Shell.

All valve types identified by the same Technical Classification Code are qualified, provided that the manufacturer confirms identical design. Scaling rules apply

End users specifications



MESC SPE 77-300 *“Procedure and technical specification for design validation testing of industrial valves”*

Each **Design Validation Testing** includes a performance test at ambient, at maximum and at minimum design temperature, as specified in the MESC Buying Description, at both low pressure and design pressure. (Leakage rate ISO 5208)

In general every test program is per temperature range

- Seat leakage & torque test
- Incremental seat leakage
- Shell test
- Dynamic & Static FE
- HP seat leakage & torque

+ Mechanical and Temperature cycles

End users specifications



GIS 61-013 / GIS 62-016

Additions to API standards. European Economic Area (EEA) countries (European Union [EU] plus European Free Trade Association [EFTA]) shall comply with relevant requirements of the PED.

For Isolation applications, additional FEA calculations are required and special testing (pressure increments of 10 bar to mimic the failure of upstream seat)



Valves ordered for major capital projects (MCP) shall require additional NDE. In general Chevron pushes for PR2 on many of those MCP.

Scaling



Acceptance Sampling and qualification ranges

Sampling

“Selection of a subset of individuals from within a statistical population to estimate characteristics of the whole population”

Qualification range

Selection of items that ensure properties of a set of “similar” items

Scaling

Selection of certain size / class to qualify a range



Examples of scaling

API 6A PR tests

- Pressure class validates equal and below
- Size validates one size above and one below
- 2 sizes validate the entire range



API 6FA Fire Test

- Size validates two sizes above (same soft material)
- Pressure class validates two classes above
- 12" validates up to 24", 14" up to 28", 16" qualifies all larger valves

API 607 Fire Test

- 8" qualifies 12" and larger

One size fits All ?

