

# Triple Offset Metal Seated Butterfly Valve: a step forward in valve design, a proven product for any application

Mousa Alharbi  
Saudi Aramco

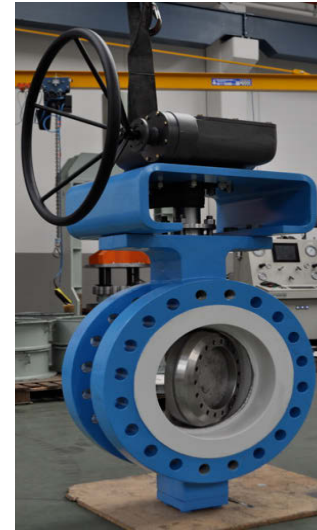
&

Andrea Gnechi  
Fluicon Valves



# Paper overview

- Introduction of Butterfly Valves
- Advantage of Butterfly Valves
- Comparison of DOBV & TOBV
- Design Features of TOBV
- Application Suitability and advantages of TOBV
- Design and Manufacturing Considerations
- Operation Conditions and Installations
- Qualifications and Design Proofs
- Future Developments of TOBV
- Summary



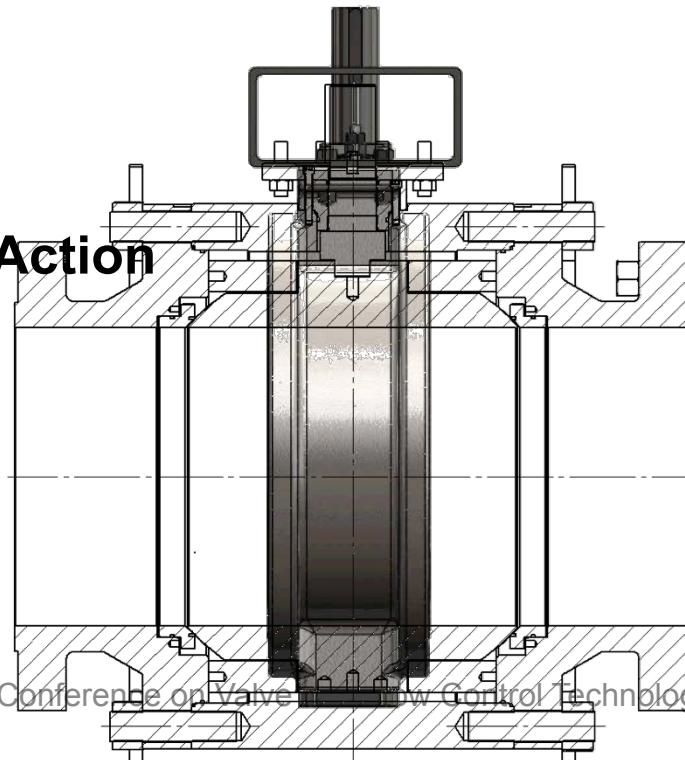
# Introduction to Butterfly

- Variety of Valve Types
- Operation Mechanism
- Types of Butterfly Valves
  - Concentric
  - Eccentric
    - Single Offset
    - Double Offset
    - Triple Offset

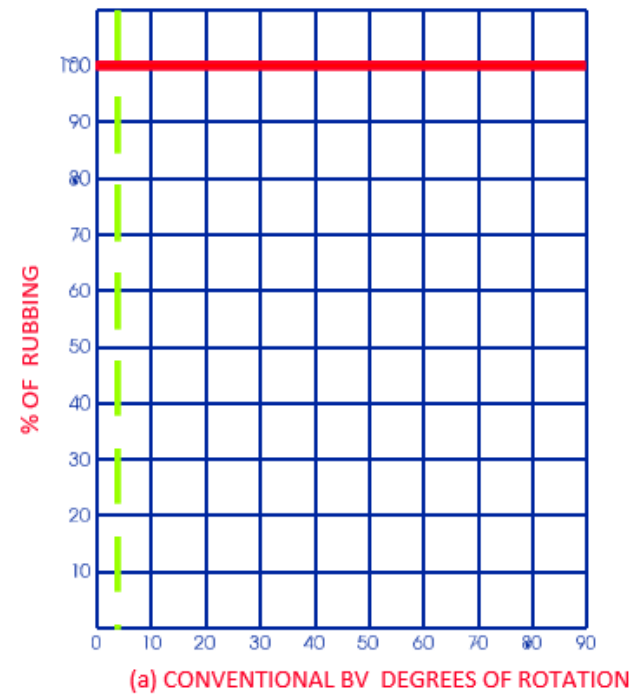
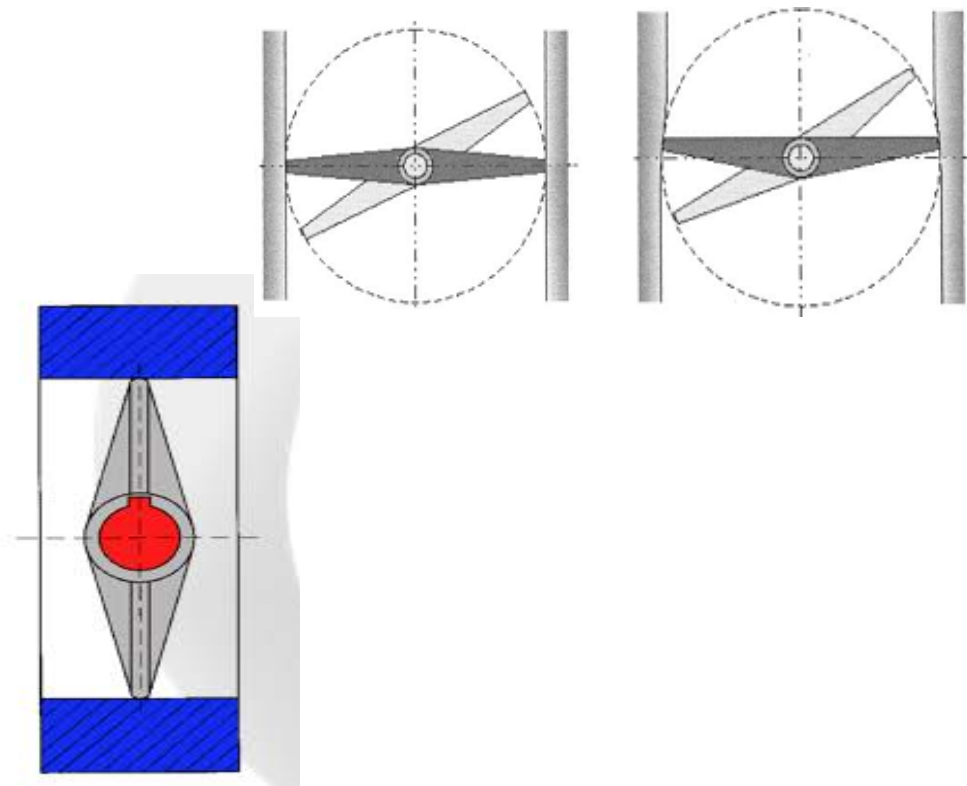


# Advantages of Butterfly Valve

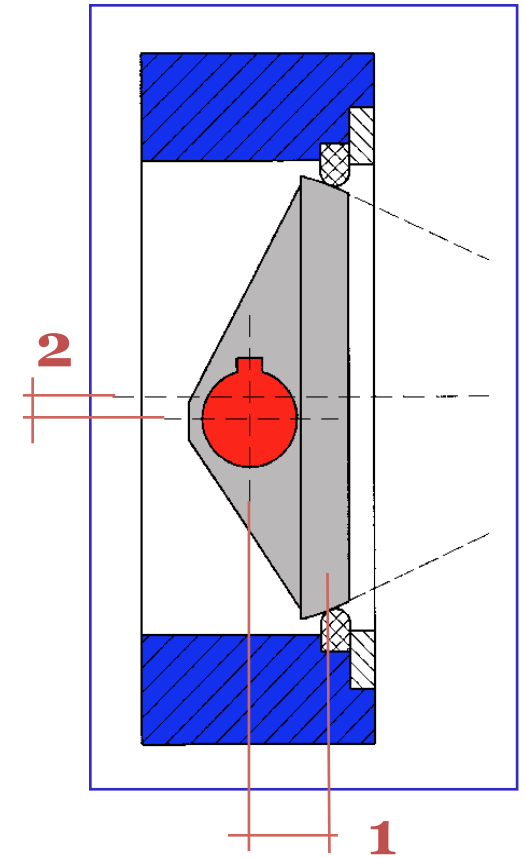
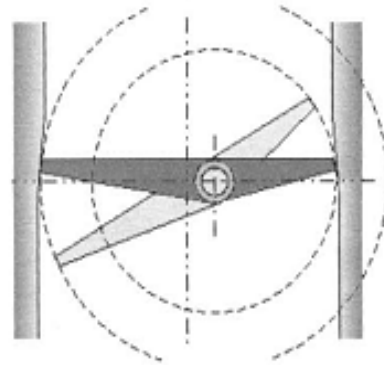
- **Economical**
- **Light Weight & Compact**
- **Performance Superiority**
- **Moderate Throttling**
- **Fugitive Emission**
- **Low Torque and Fast Action**



# Conventional Butterfly Valve Overview

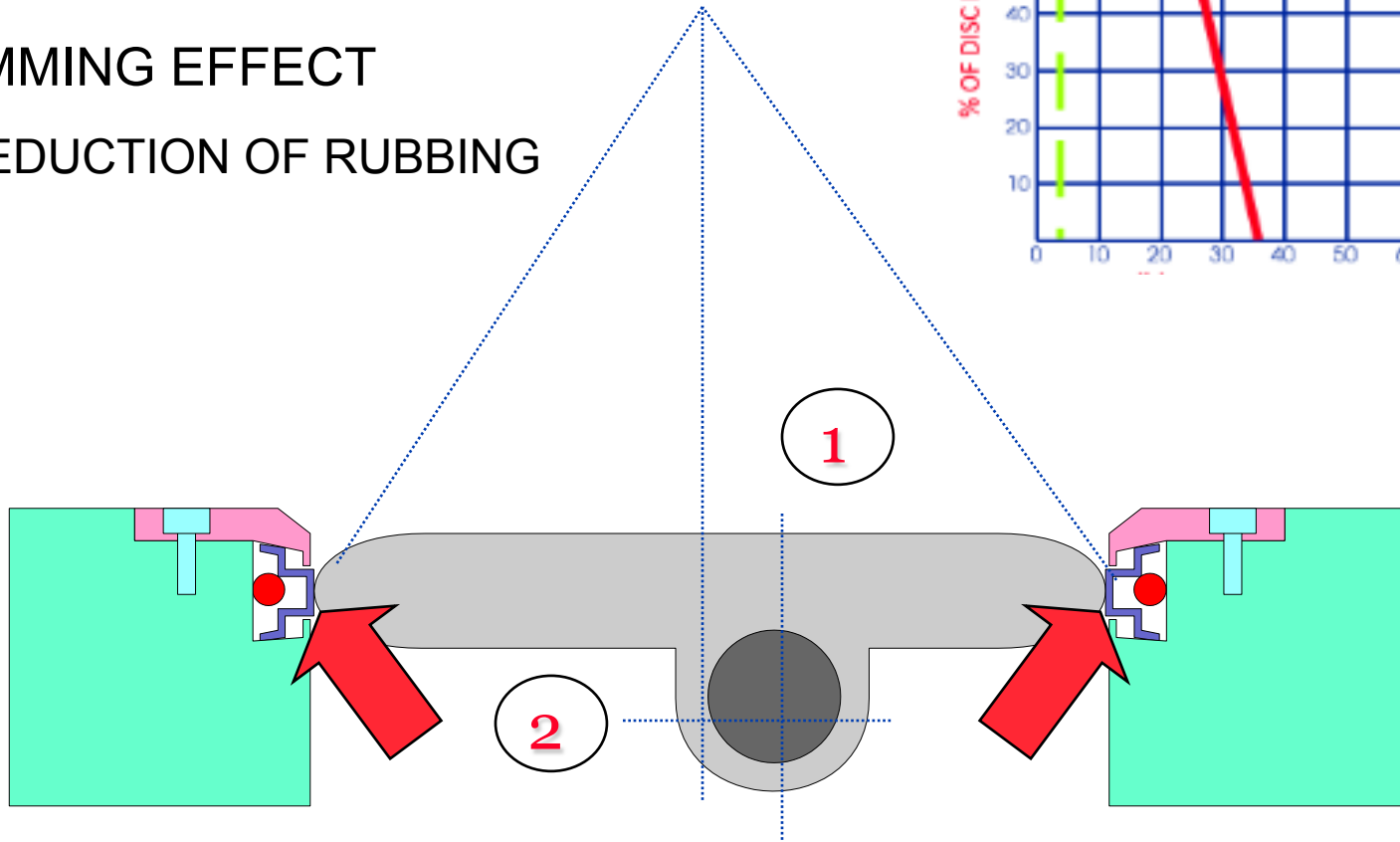
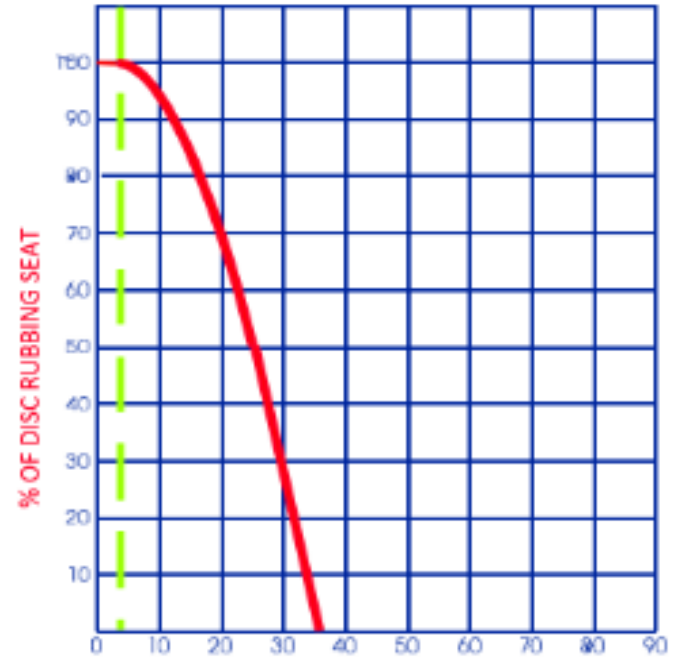


# DOBV

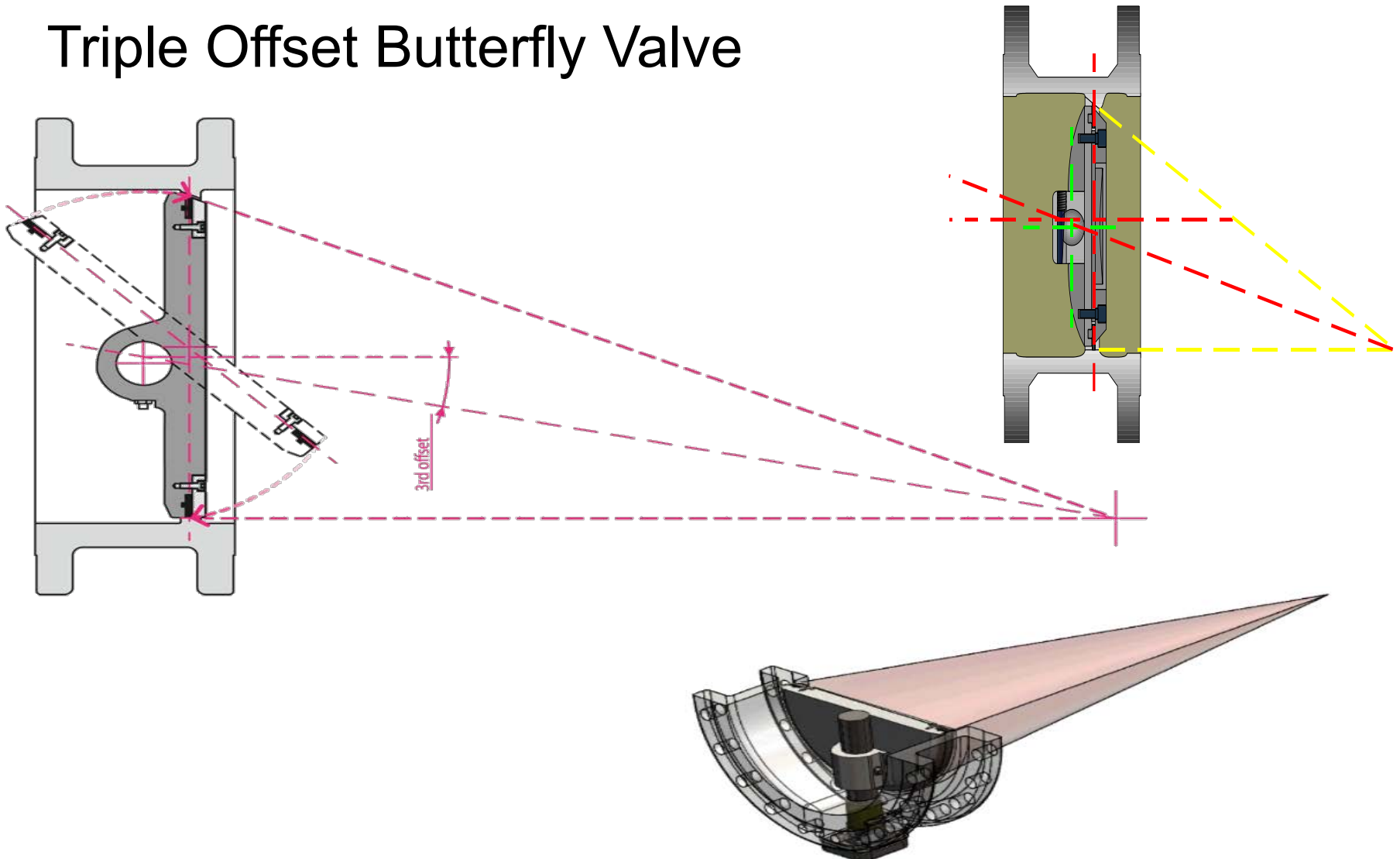


# DOBV

- CONTINUOUS CONTACT
  - POSITION SEATED
- CAMMING EFFECT
  - REDUCTION OF RUBBING



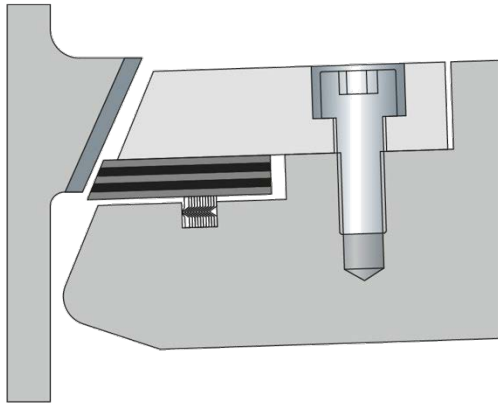
# Triple Offset Butterfly Valve



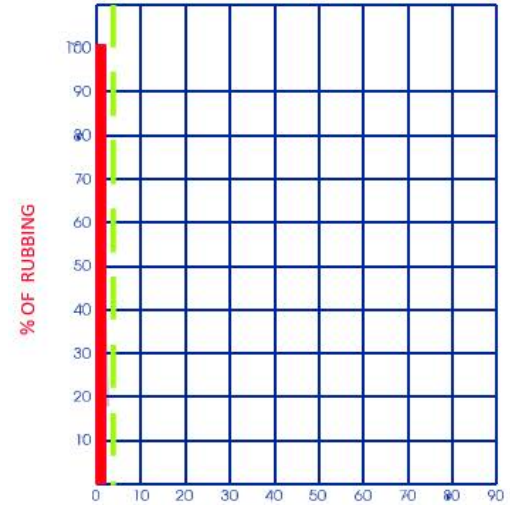
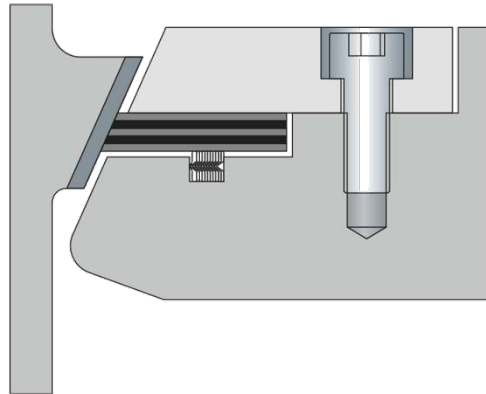


# TOBV vs. DOBV

VALVE CLOSING

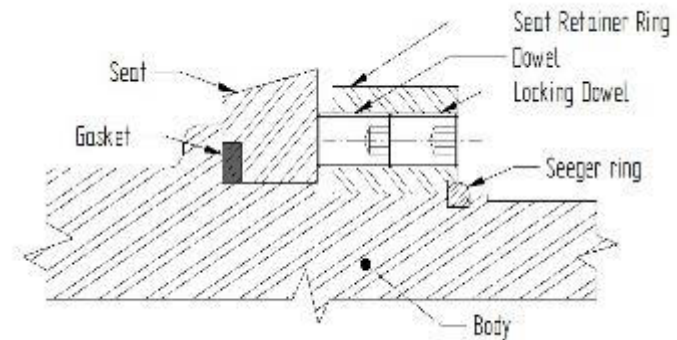
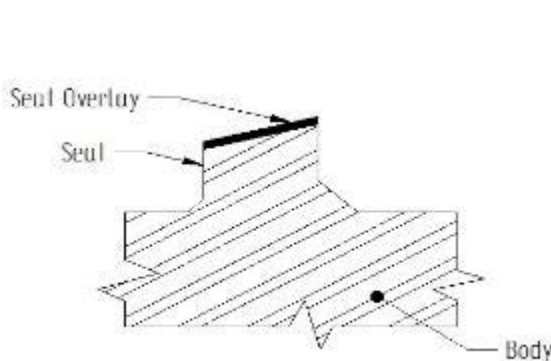
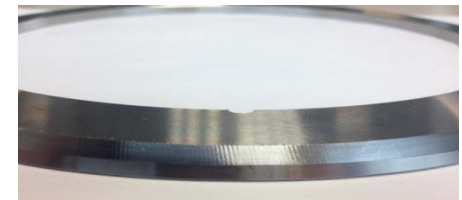
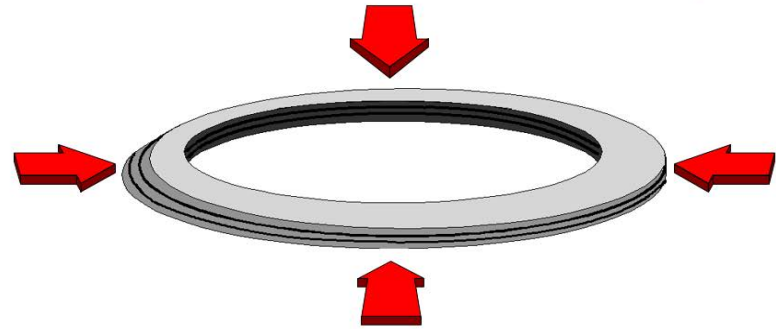


STRESSED SEAL



# Added Values of TOBV

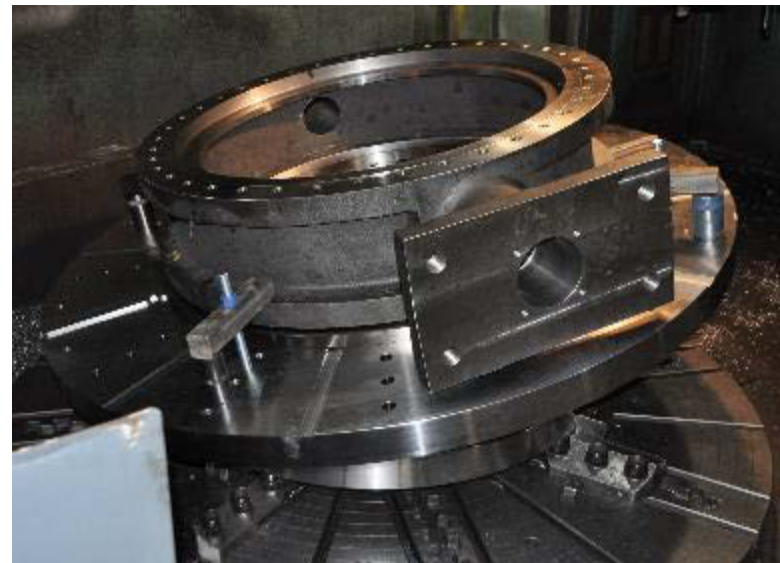
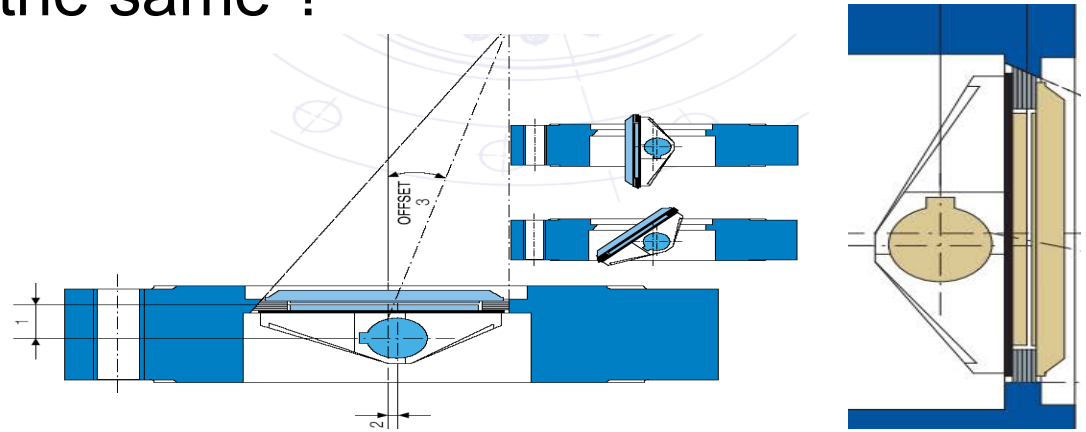
- Distribution of Stresses
- True MTM Sealing
- Integral or Renewable seats



# Design and Manufacturability Considerations

## Will all TOBV perform the same ?

- Contact Angles
- Material Selection
- Critical Machining
- Delicate Tolerances
- Engineering Involvement



# True Understanding of Requirement

- Zero Leakage
  - TSO vs Bubble Tight

**FCI 70-2 class V or class VI**

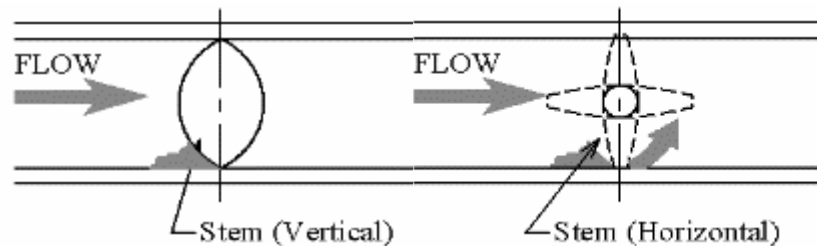
**API 598 & API 6D, ISO Classes metal seated means**

**ALLOWABLE LEAKAGE**

- Actuator sizing and Preferred Direction
- Fugitive Emission

## Operating Conditions and Installations:

- Direction of the flow:
- Installation Orientation
- Temperature Cycles
- Startup conditions:



# Qualifications and Design Proofs

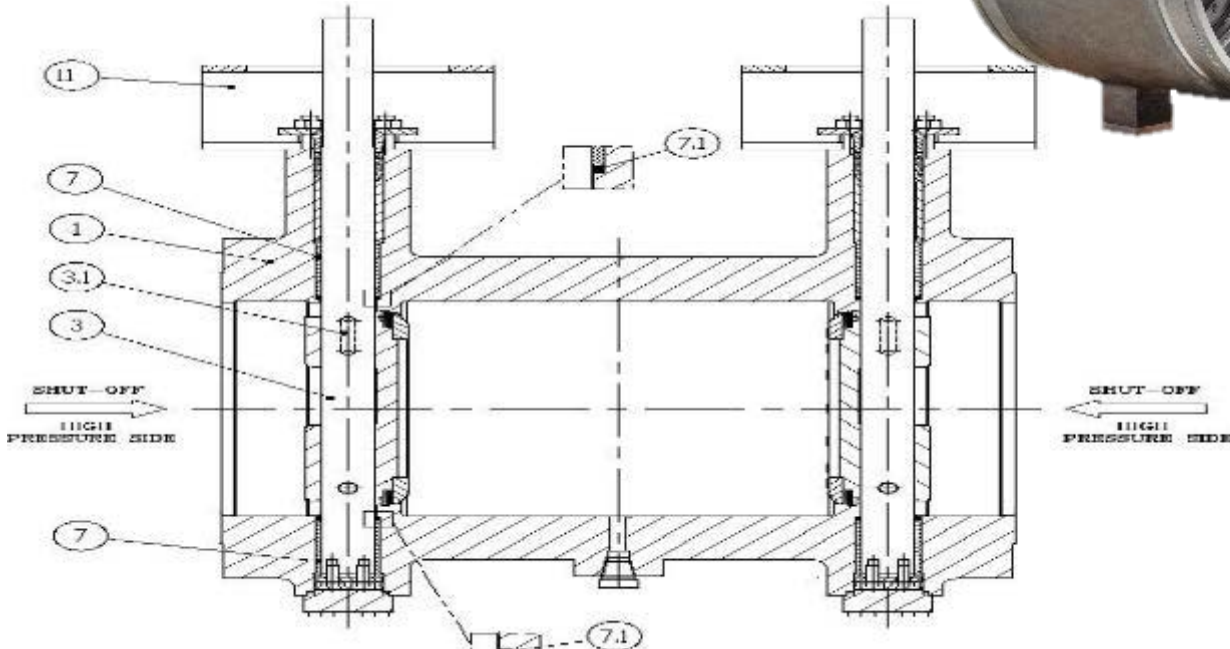
- Qualification Testing vs. Production Testing
- Cryogenic and Low temperature Test
- High Temperature Test
- Dynamic/endurance Tests
- Seal type test
- Fugitive Emission Test
- Special Process Simulation Qualifications

# Application Suitability and Advantage of TOBV

- High Temperature
- Cryogenic
- Harsh/Unclean & Slurry
- Fugitive Emission
- Complex piping systems
- Unsteady Locations i.e., platforms, vessels ...etc.

# Specialty TOBV

- Higher Pressure Envelopes up to 2500 #
- Top Entry TOBV
- Enhanced Steam Jacketed TOBV:
- Double Block and Bleed TOBV
- Special TOBV





## Future development of TOBV

- New Metallic Seat Materials
- Subsea Application
- Dual Performer Butterfly (Control-Isolate Valve)
  - A control and an isolation valve in one body.



# Summary

- Types of Butterfly Valves
  - Confusion between the types of butterfly limited its market penetration
- Proven Promising Design and Performances
- Field Trust in Various Applications

**Thank You**



**INDUSTRIAL VALVE SUMMIT**



# Addendum

# Leakage Comparison

**API 598 leakage is in drops/min (liquid) and bubbles/min (air)**  
**API 6D & FCI 70-2 leakage is in ml/min**

Diameter		API 598 Metal Seated		API 6D Metal Seated		API 598/API 6D Soft Seated	FCI 70-2 Class VI
MM.	INCH	Liquid	Air (*)	Liquid	Air (**)	Liquid/Air (*)(**)	Air
80	3"	12	24	0.46	14	0	0.90
100	4"	12	24	0.61	18	0	1.70
150	6"	12	24	0.91	27	0	4.00
200	8"	20	40	1.21	36	0	6.75
250	10"	20	40	1.52	45	0	11.10
300	12"	20	40	1.83	54	0	16.00
350	14"	28	56	2.14	63	0	21.60
400	16"	28	56	2.44	72	0	28.40
450	18"	28	56	2.74	81	0	-
500	20"	28	56	3.05	90	0	-
600	24"	28	56	3.66	108	0	-
750	30"	28	56	4.57	135	0	-
900	36"	28	56	5.48	162	0	-
1000	40"	28	56	6.40	189	0	-

**FCI 70-2 class VI does not define leakage above 16"**

**FCI 70-2 class VI test is performed always at 3 bar independently from the valve rating**

**(\*) API 598 air test is required for metal seated ball and butterfly valves**

**(\*\*) API 6D air test is optional**

