

# Permanent impermeability monitoring of the stem sealing of valves

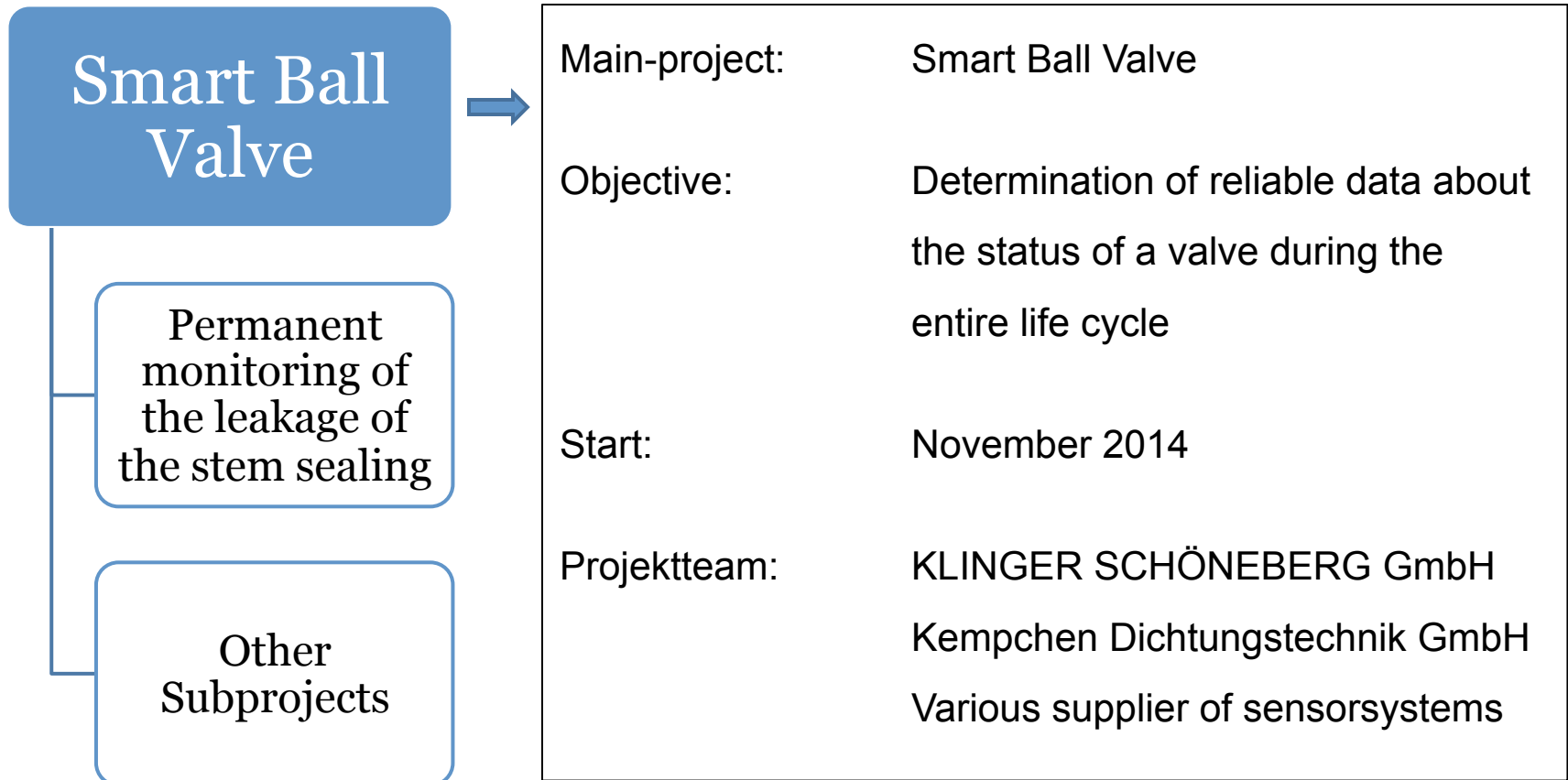
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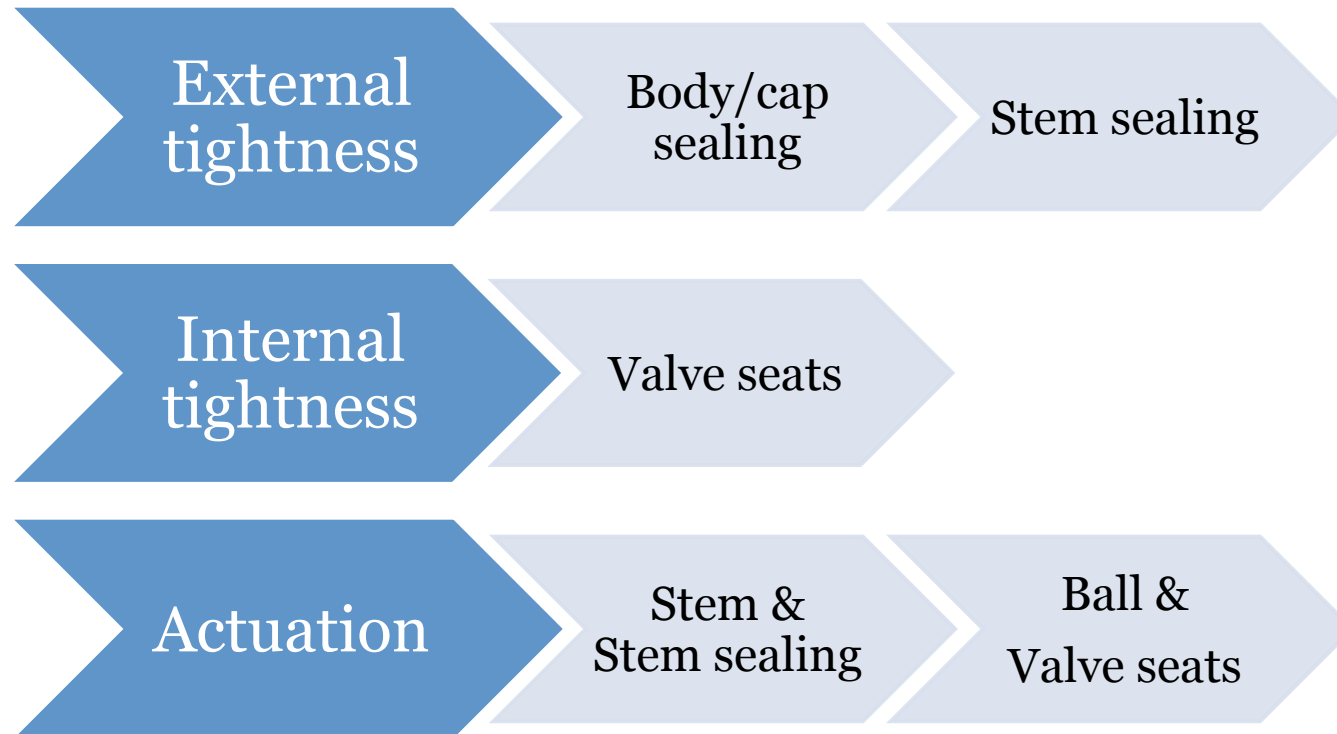


# Project overview



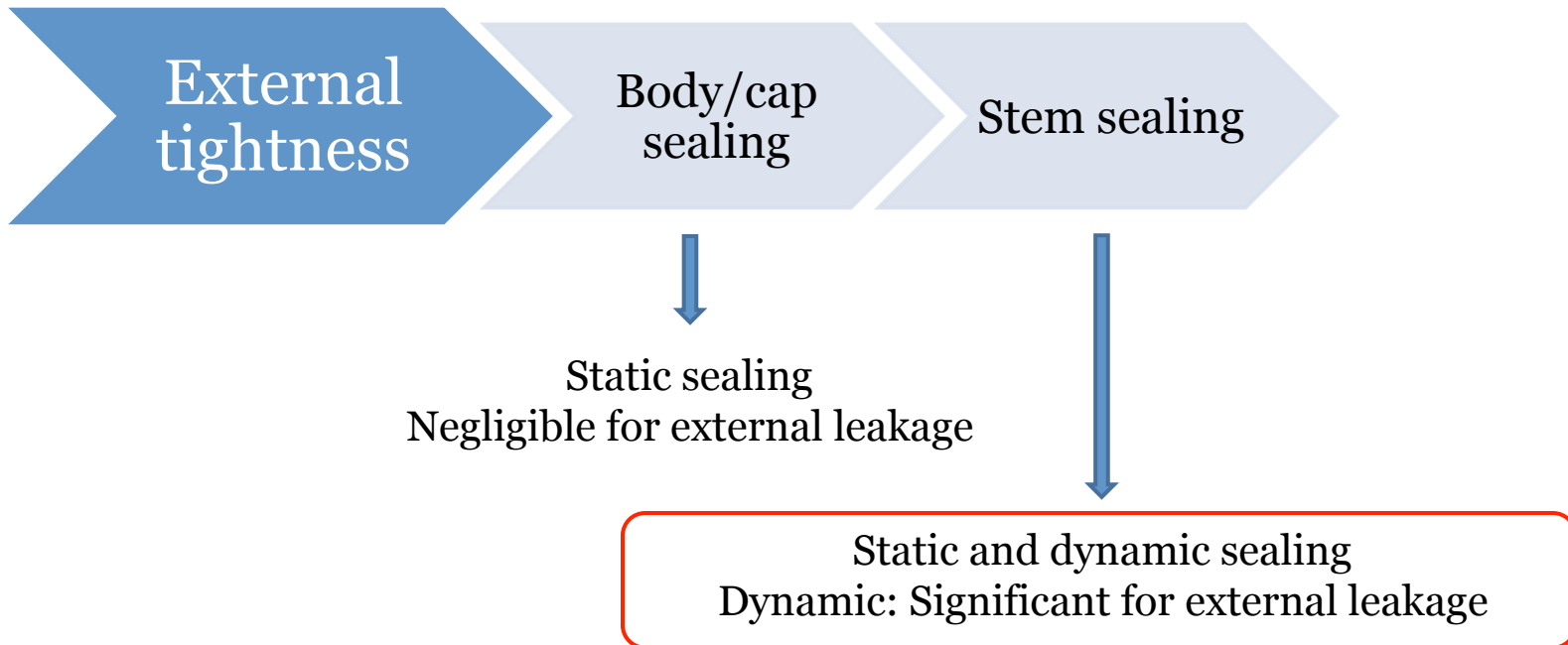
# Project overview – ‘Smart Ball Valve’

## Main topics



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# Project overview

Sub-project: Permanent impermeability monitoring of the stem sealing of valves

Objective: Development of a system for the permanent and direct tightness monitoring and analysis of the stem sealing of a quarter turn valve

Timeline: November 2014 → June 2015

Projektteam: KLINGER SCHÖNEBERG GmbH  
Kempchen Dichtungstechnik GmbH  
Various suppliers of sensorsystems

# Project overview

## Main issues

- Permanent monitoring of the tightness of the stem sealing
  - Not only as a snapshot under testing conditions or under operation conditions elaborately with sniffing equipment
  - Monitoring in all operating conditions (independent of media, process pressure, process temperature, process-related load changes, ...)
- Applicability of the system to all quarter turn valves
  - Comparability of various valve types of various valve manufacturers
  - Independence of tests and certificates of manufacturers and inspection companies

# Project overview

## Main issues

- Recording and analysing of data of the system
    - Statements about the remaining functionality of valves regarding external leakage
    - Combination of data regarding the external leakage with other data of monitored valveparts/ functions
      - Maintenance and substitution of valves when needed not preventive
      - Test cycles of valves/ plants regarding realistic estimation
      - Extension of the MTBS (MeanTime Between Shutdown)
- Increasing of the safety in the working areas and the environment
- Reducing of the maintenance and loss of production costs

# Current status

## Completed Tasks

### Defining of specification book and requirements list

- About 50 requirements defined
  - Function
  - Geometry
  - Leakage limits
  - Materials
  - Signal transmission
  - Manufacturing
  - Assembling
  - Usage
  - Maintenance-free
  - Reuse of parts
  - ...



# Current status

## Requirements list – extract

### Permanent monitoring of the leakage of the stem sealing

- Monitoring of leakage values below thresholds acc. to ISO 15848 or VDI 2440 (national german regulation)

E.g. VDI 2440 →  $T < 250^{\circ}\text{C}$  →  $10^{-4}$  mbar\*liter/(second\*meter)

Ball Valve INTEC K200 DN50 PN40 →  $10^{-5}$  mbar\*liter/second

(middle circumference of the sealing = 0,09m)

Flow types	Leakage rate [mbar*l/s]
Turbulent	$>10^{-2}$
Laminar	$10^{-2} - 10^{-6}$
Transition	$10^{-6} - 10^{-7}$
Molecular	$<10^{-7}$

Leakage Testing Handbook, Prepared for Liquid Propulsion Section, Jet Propulsion Laboratory, National Aeronautics and Space Administration, Pasadena, California

# Current status

## Completed Tasks

### Finding of principle solutions

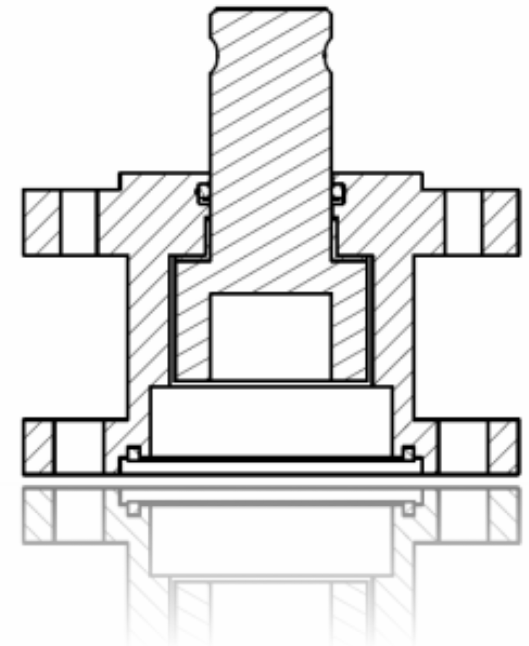
- Team
- Development of possible principle solutions regarding the task
- Selection of the most promising solution
- Arrangement of the further development of this solution

# Current status

## Completed Tasks

### Further development of the selected solution

- Tight Chambering of the area above the stem sealing
  - Guarantee of functionality of the actuation
- Measurement of the pressure changing in the chamber regarding the leakage
  - High sensitive sensorsystem
- Conjunction of the pressure changing with leakage values and admissible emission limits
- Conjunction of the sensorsystem with smart software to forecast the exceeding of the emission limits
- Direct and straight measurement of the leakage of the stem sealing

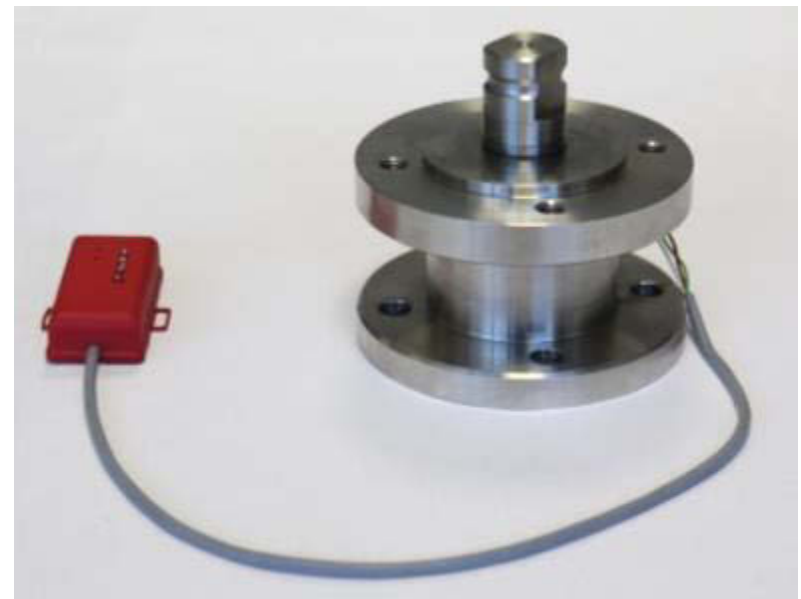


# Current status

## Completed Tasks

### Production of prototypes

- Parts for the connection of valves and actuators
- Assembly of the high sensitive sensorsystem



# Current status

## Completed Tasks

### Testing of the prototypes

- Monitoring of the leakage of the stem sealing of a standard valve with a helium mass spectrometer
- Monitoring of the leakage with the new system
- Comparison of the determined values

Testing conditions	
Valve	INTEC K200 DN50 PN40
Test device	Leybold Ultratest UL 100 Plus
Inseption sensitivity	$2 * 10^{-10}$ mbar*1/s
Medium	Helium 99,996%
Pressure	6bar
Temperature	23°C



# Current status

## Results of the tests

The first tested prototypes don't fulfill all of the defined requirements

- The recorded signals of the sensor cannot definitely be assigned to leakage values
- Within the leakage range of  $10^{-8}$  mbar·l/s to  $10^{-2}$  mbar·l/s it is difficult to get repeatable signals
- No possibility to generate reliable data for the analysis below  $10^{-2}$  mbar·l/s

## Realised reason

The sensitivity of the used sensor is not sufficient for the requirements

# Looking forward

## Next steps

- Research about sensors with a higher sensitivity
- Producing of a new prototype of the sensorsystem
- Testing of the system with the same test conditions

## Expected results

Recording of sensorsignals witch can be definitely assigned to leakage values within the leakage range of  $10^{-8}$  mbar\*l/s to  $10^{-2}$  mbar\*l/s

# Looking forward

## Interim conclusion

- Sub-project in final development status
  - Positive results will be expected
- Mainproject 'Smart Ball Valve' will be followed up and finalised in the near future
  - Plant operators will be in a position to save costs and operate their plants safely



Thank you for your attention!