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# ***A New Test Facility for Investigating Fluid-Structure Interactions using a Generic Model***

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## Aeroelastic problems

*(Fluid-structure Interaction)*



- Shorter lifetime
- Fatigue Failure
- Explosive Failure

*(Flutter self sustained vibrations)*

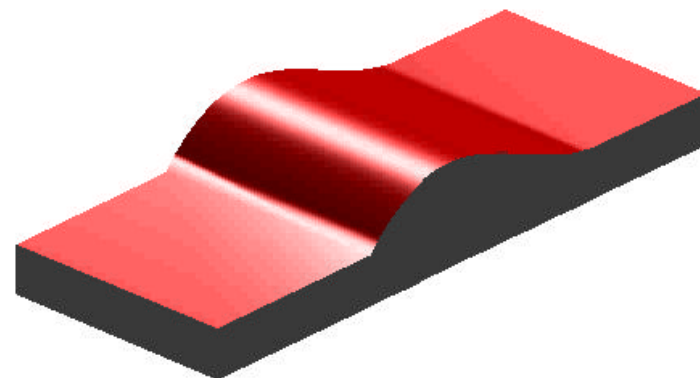
### ➤ Environment:

- complex aerodynamic and geometry
- 3D flow phenomena
- shock wave motion in transonic flow
- 3D structures and 3D mode shapes

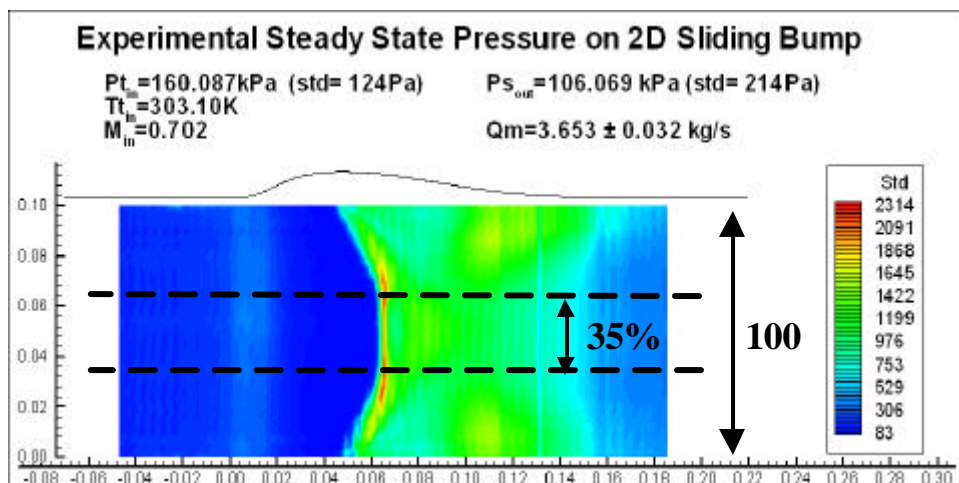
Real blades

Generic model

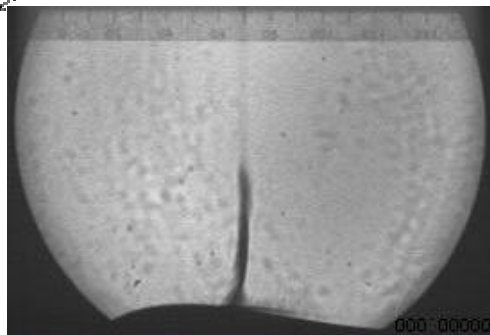
1st Bending mode



## Fully 2D experimental model:



- 2D prismatic model
- 1<sup>st</sup> bending mode shape
- 2D transonic flow



**Identification and conservation of main flow phenomena:**

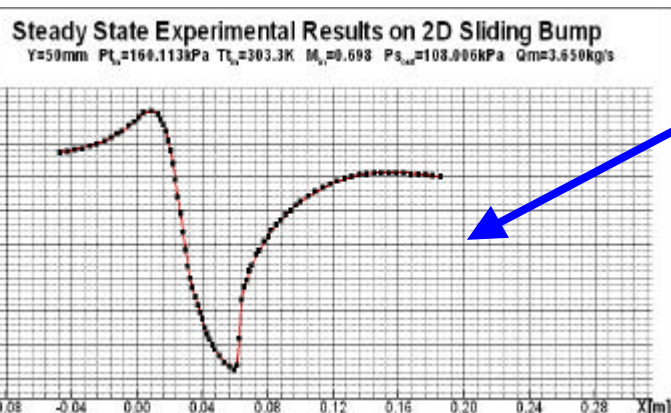
- **Transonic flow conditions**

- **Pressure gradient on surface**

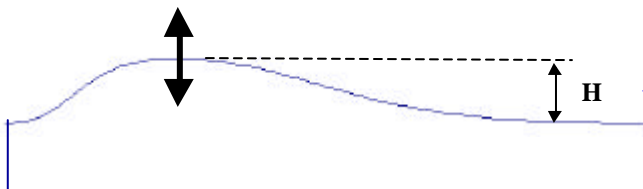
**Identification and conservation of main aeroelastic parameters:**

- **Reduced frequency based on the half chord:  $k = 0 \dots 2.8$**

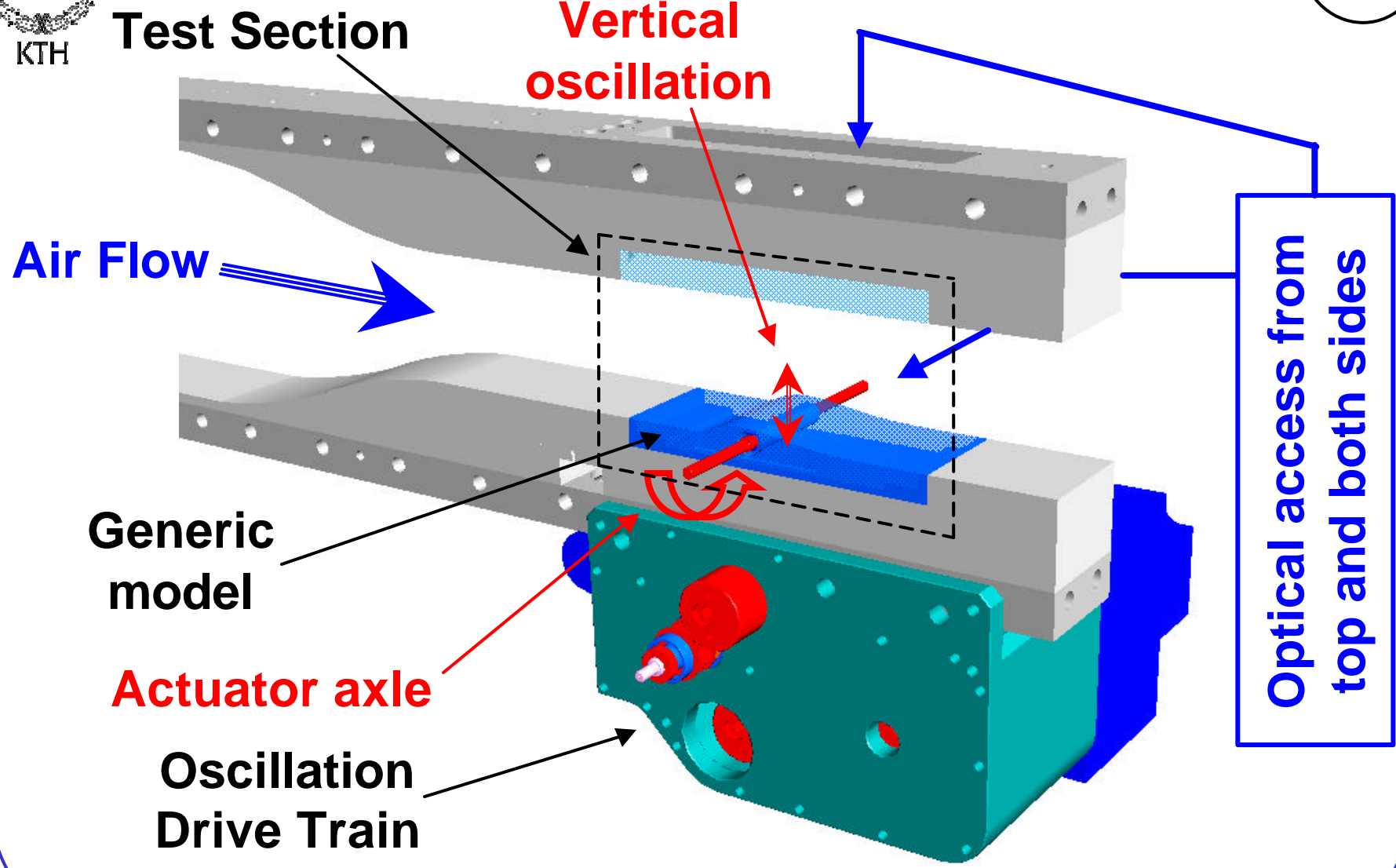
- **Amplitude:  $0 \dots 10\%$  of  $H$**



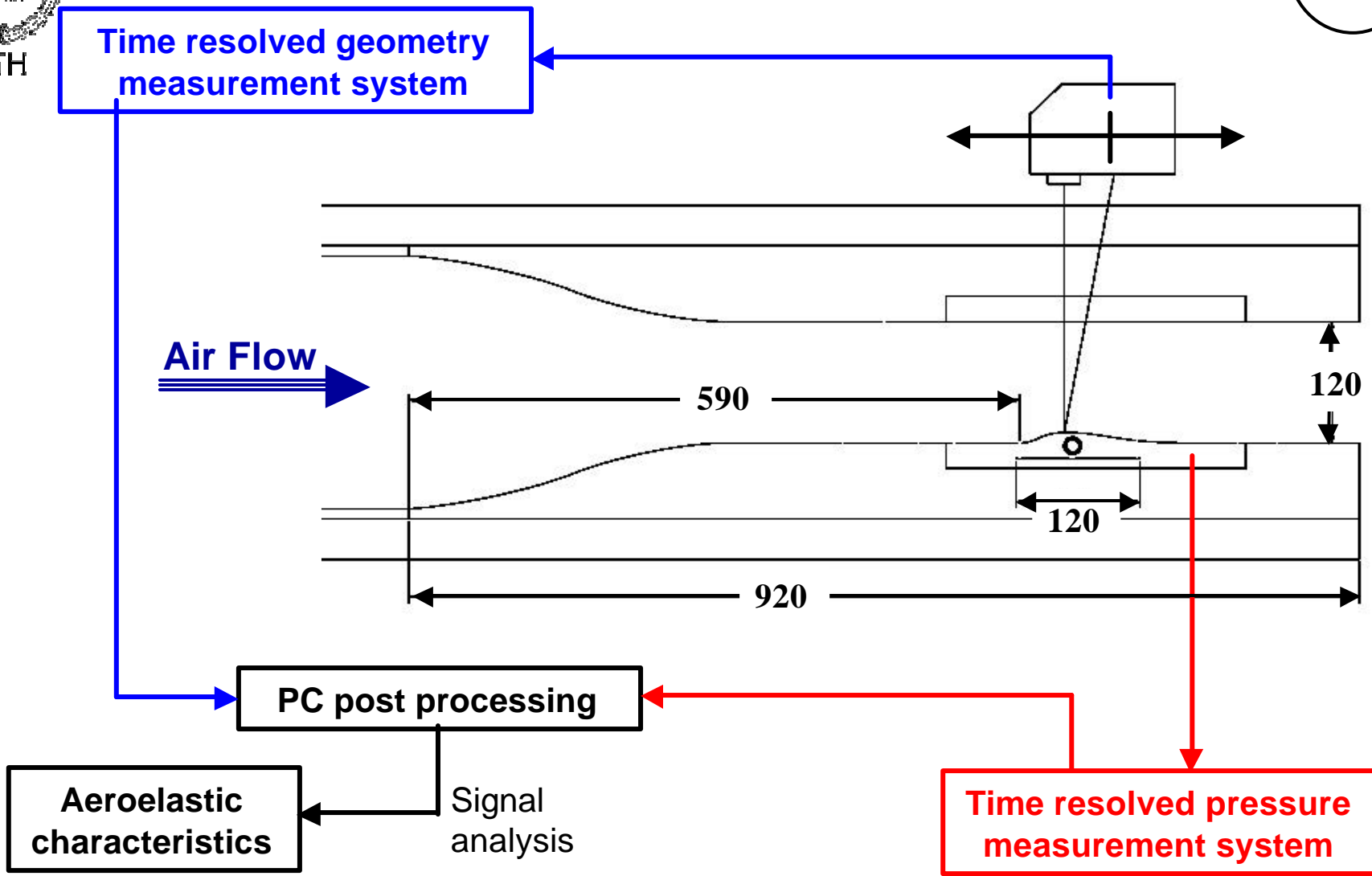
vertical oscillations



# Test Facility



# Experimental Set-up





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# The Generic Flexible Model



**Polyurethane**

*flexible*

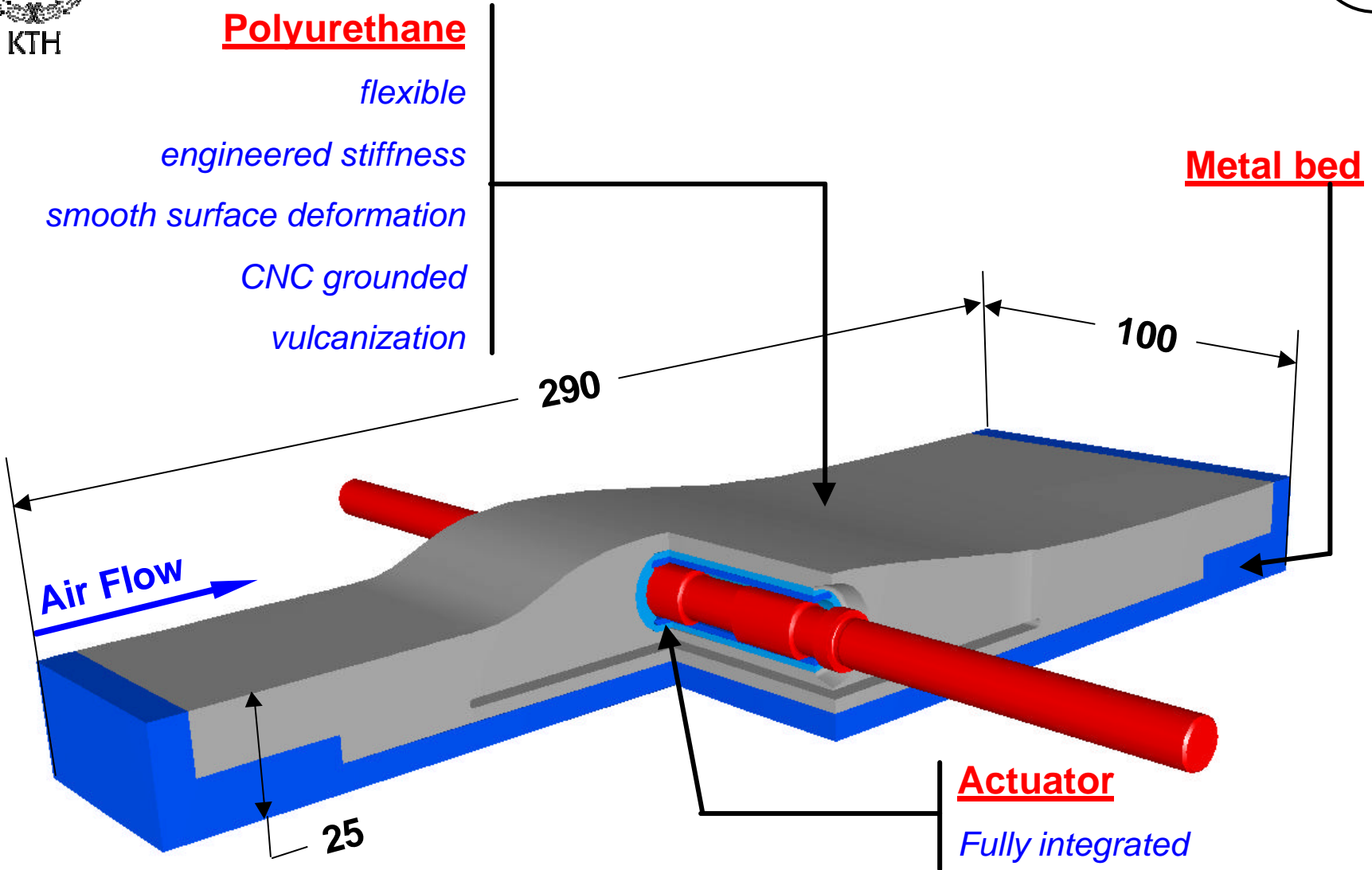
*engineered stiffness*

*smooth surface deformation*

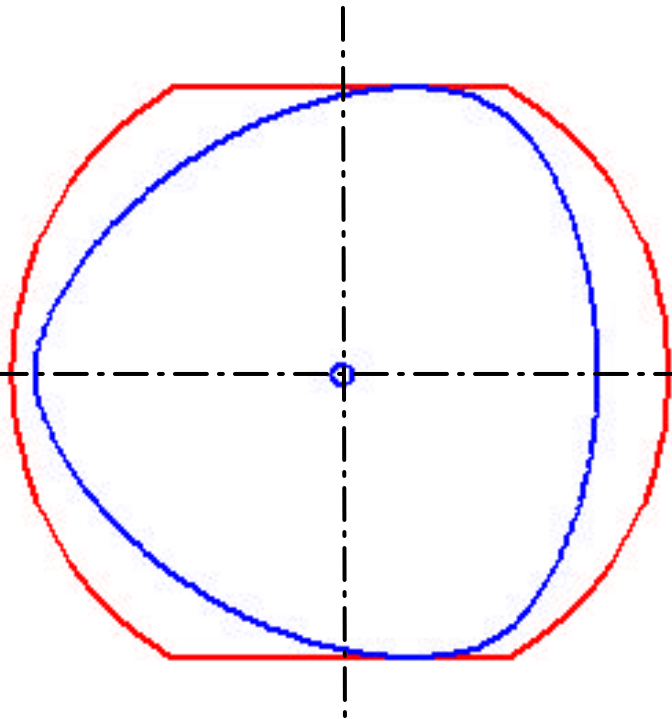
*CNC grounded*

*vulcanization*

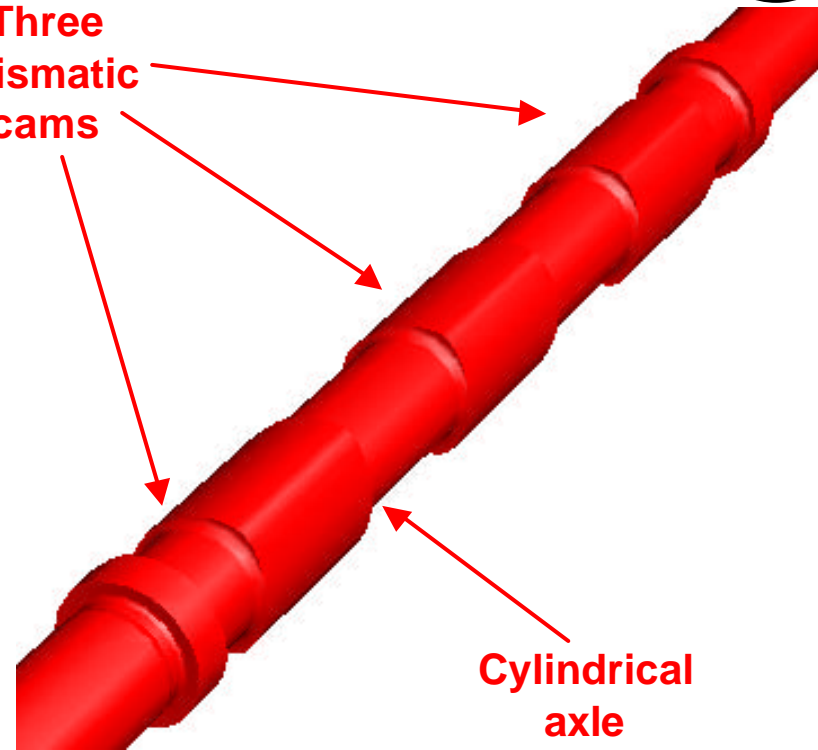
**Metal bed**



# The Oscillating Actuator



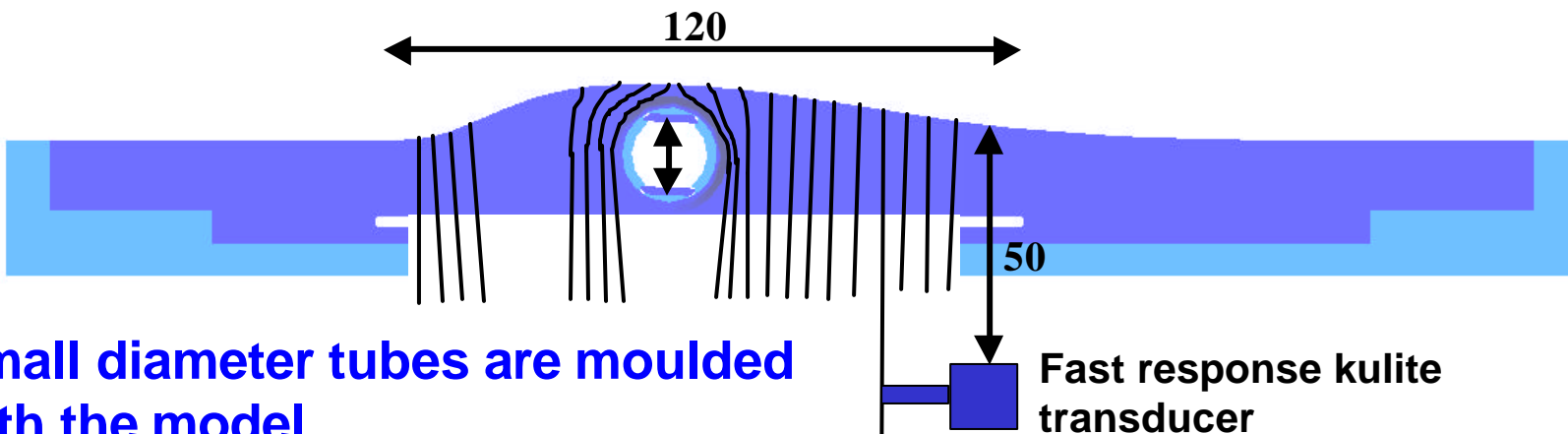
Three  
prismatic  
cams



Cylindrical  
axle

- Friction contact, Oil system lubrication
- 3 oscillation cycles per revolution of the camshaft
- Adaptable for several actuators (stripe modes)

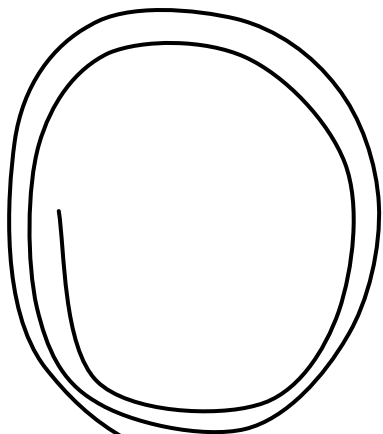
# Unsteady Instrumentation



**Small diameter tubes are moulded with the model**

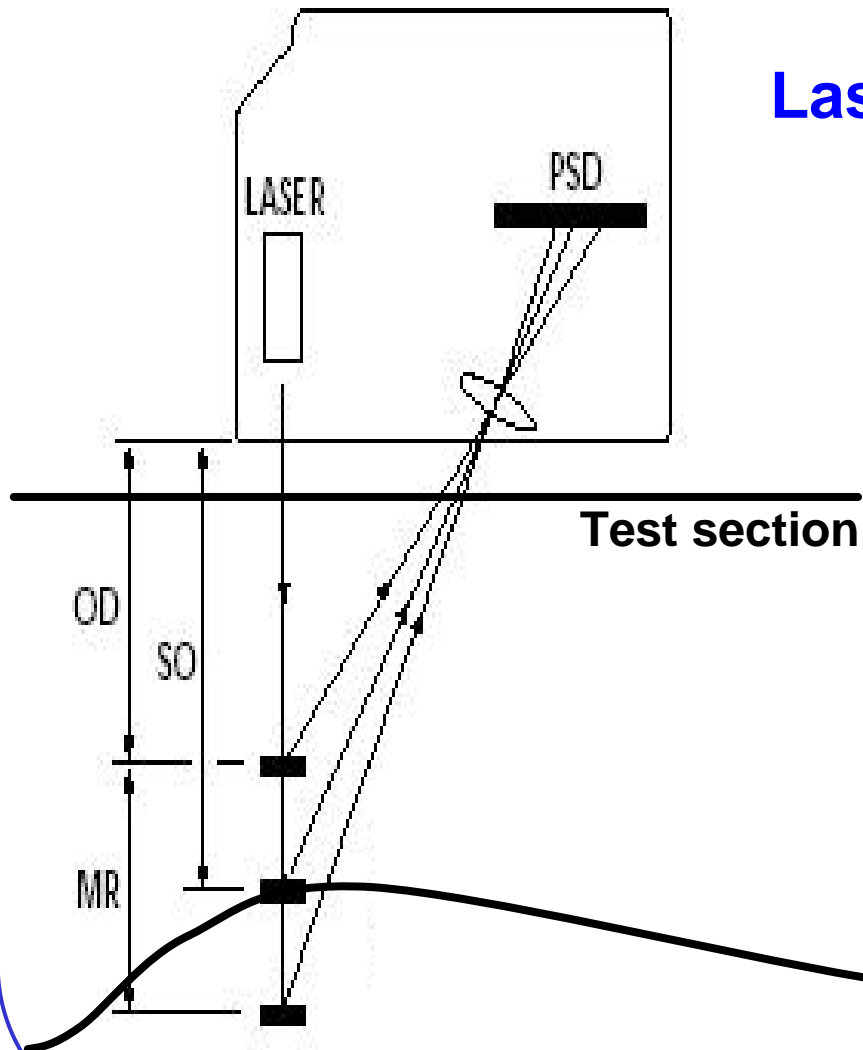
## Calibration:

- delay
- transfer function
- motion of the bump
- acceleration



**Long line probes**

5m long pipes



## Laser Triangulation:

- 1D laser sensor
- Focus in MR
- Non-intruding
- Resolution = 0,003mm
- Bandwidth = 20kHz
- MR = 15mm
- SO = 200mm



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# Conclusions

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- **Development of a generic model for aeroelastic investigations**
- **Flexible structure, controlled motion, measured geometry**
- **2D generic model preserving key flow parameters**
- **First on-rig test will be performed soon**

## Future works:

- *Limited oscillation mode shapes:*
  - *Adaptation with several actuators*
  - *3D actuator more controllable*
- *Side walls influence on the 2D flow:*
  - *Boundary layers suction on all walls*