Enabling Engineering
Breakthroughs that Lead to a
Better Tomorrow

vibro-meter

Sensors selection for hydropower applications

Date: 20 February 2025

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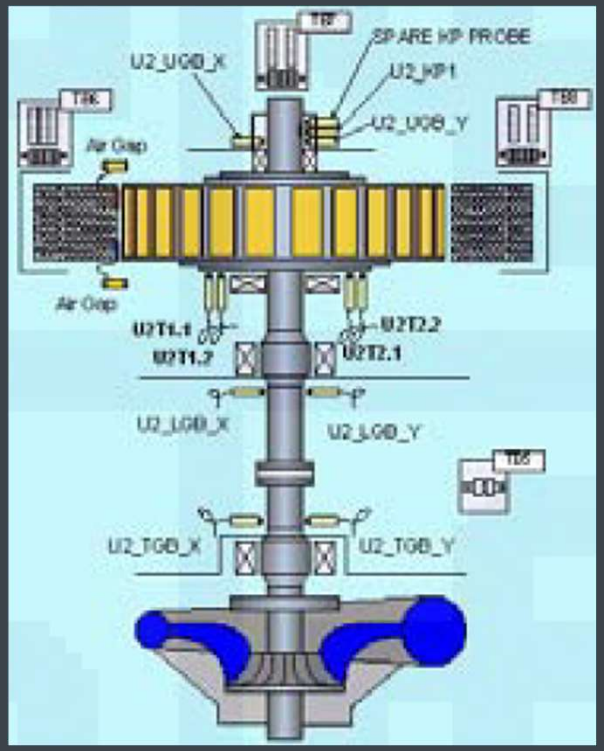
Parker MEGGiTT

AGENDA

- Introduction
  - Absolute Vibration
  - Relative vibration
  - Axial and in-water displacement
  - Airgap
  - Magnetic flux and stator vibration
- Conclusion



Introduction

Top-down approach

Why we are here.

Complete System

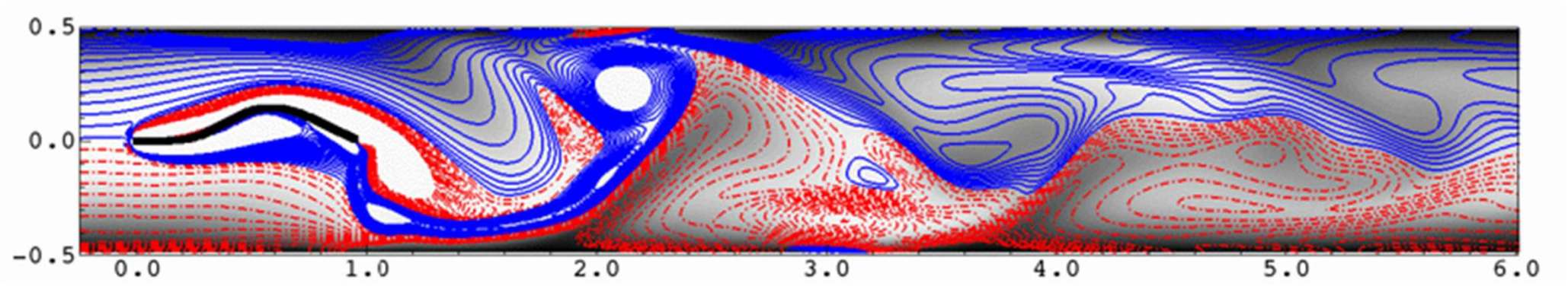
Bottom-up approach

Adequation

Quality, L.T. reliability

Absolute vibrations: Bearings, Draft-Tube, covers…

- Vortex: ~ + - 0,25X



CE620

SE 120

Absolute vibrations: Bearings, Draft-Tube, covers.

Challenging low frequencies

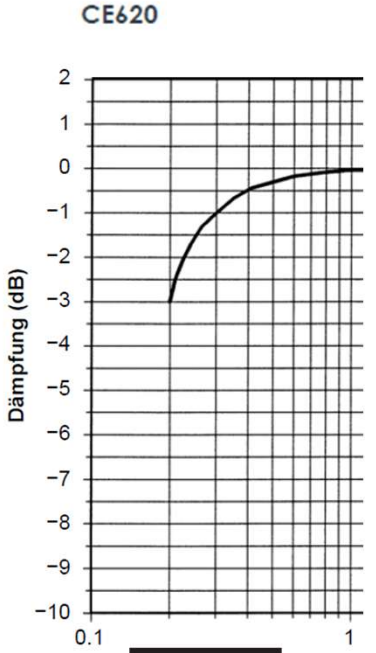
- **Low frequency Requirement:**
  - **ISO 20816-5 (new): [0,1 X .. 3xNz.X]**

: ±5%
(lower cutoff frequency is determined by the signal conditioner)

: For a high-pass filter < 5 Hz, the cutoff frequency (−3 dB) has an accuracy of ±20 % over the whole temperature range

- **Piezo-electric: no DC**
- **→ control of low frequencies?**
- **Piezo-resistive: Yes**

SE 120



- **IMPORTANT: signal power for transportation**

Absolute vibrations: Bearings, Draft-Tube, covers.

Challenging brackets

- **Piezo-electric:**

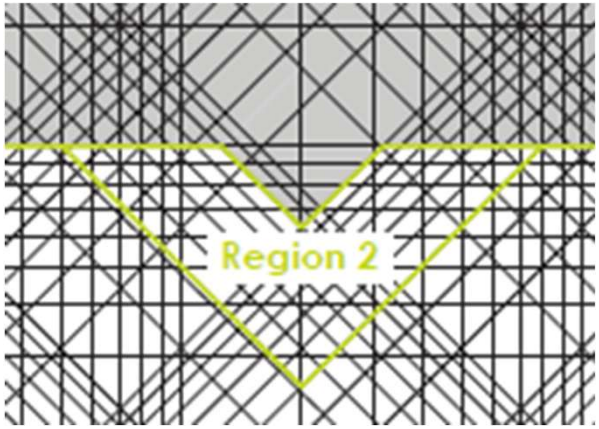
Shear mode *vs.* Compression mode

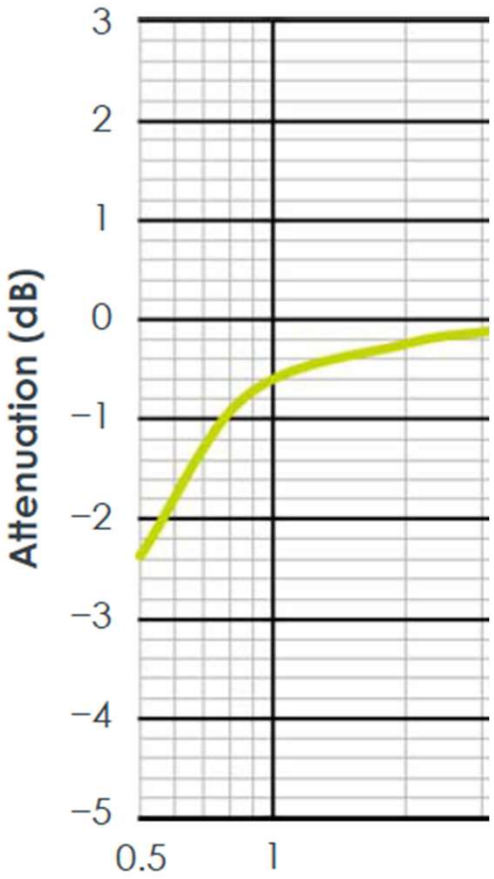
CE620

Absolute vibrations: Bearings

- **Velocimeter:**
  - Directly velocity VE210 √
  - Less performance : (gain x band)
  - Applicability zone

VE210





- Moving parts

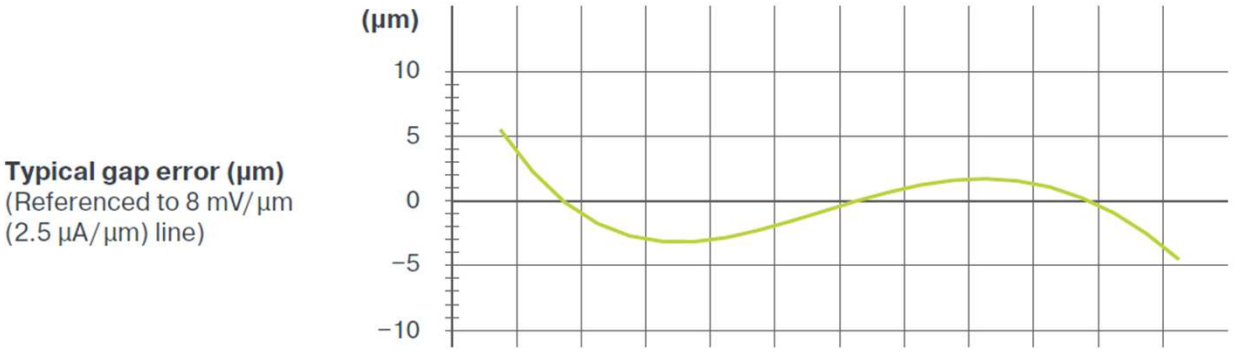
Brackets

Challenging bracketing

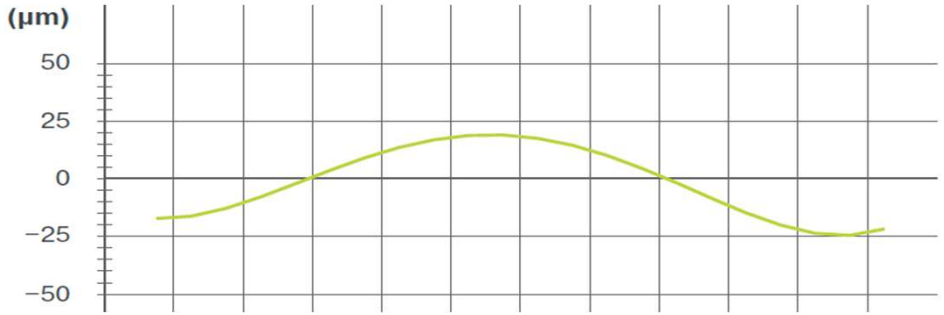
Relative vibrations: Main Shaft

Inductive technique! Challenging **range**, **runout inclusion**

Performance curves for TQ902 or TQ912 with IQS900 – 2 mm measurement range



Typical gap error (µm)
(Referenced to 8 mV/µm
(2.5 µA/µm) line)



Typical gap error (µm)
(Referenced to 4 mV/µm
(1.25 µA/µm) line)

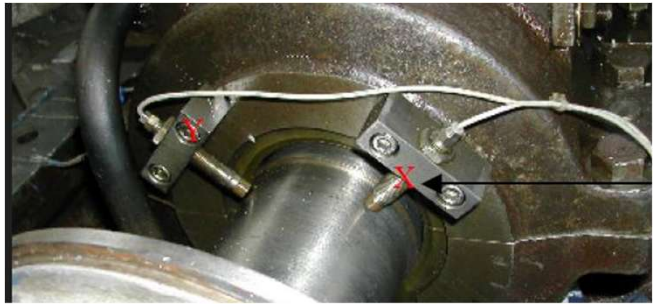
Range x2

Linearity

Slope at mid-range

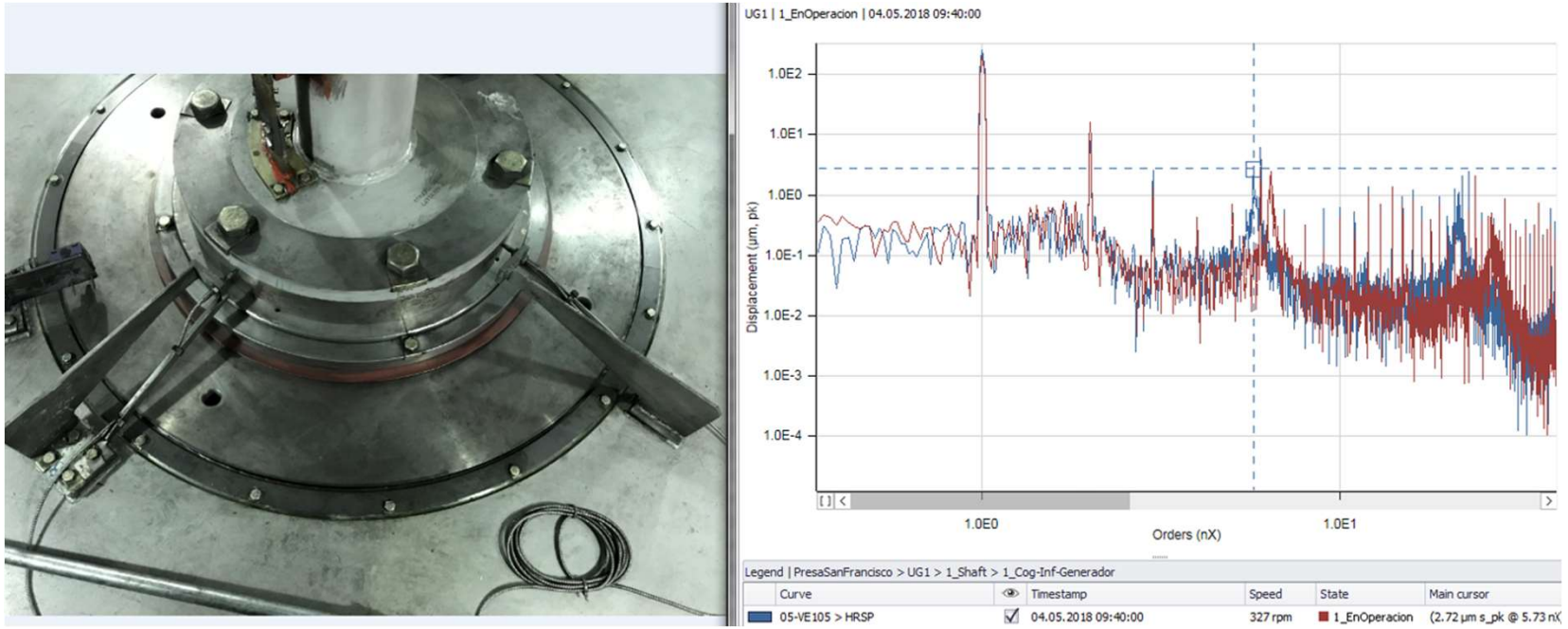
Brackets

Challenging bracketing



Brackets

Challenging bracketing



Axial position; AND vibrations, at thrust bearing

Challenge: machine maintenance

Not in ISO 20816-5

- **Displacement: long range**

RE 022, RE 030

TQ403

IQS900

- **Absolute vibration**

CE620

SE 120

Axial position; AND vibrations, at thrust bearing

Challenge: machine maintenance

Not in ISO 20816-5

- **Displacement: long range bracket**

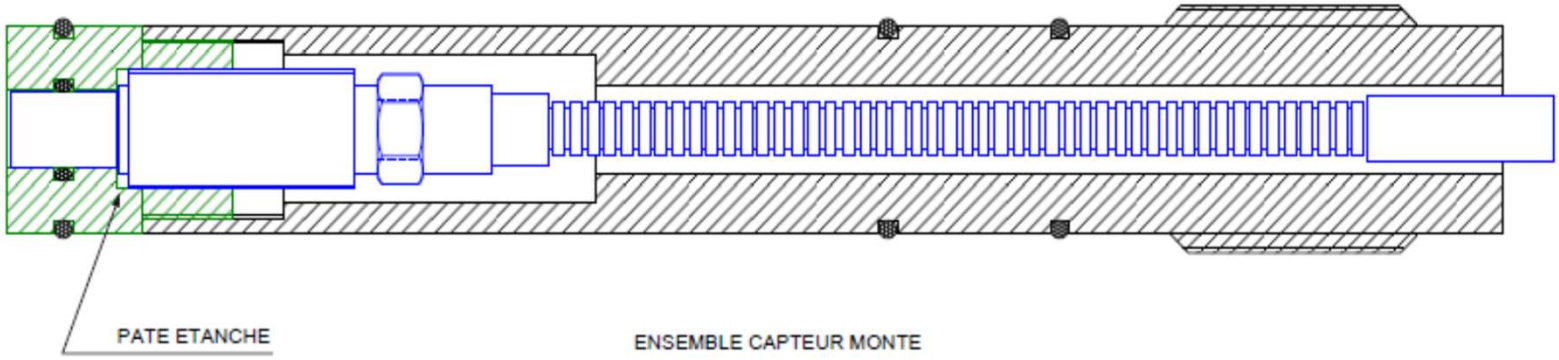
Runner clearance

- Challenge: Pressure, cavitation, wear, calibration

Not in ISO 20816-5

- Displacement: in high water pressure
- Probe holder
  - For adjustment
  - Waterproof under pressure
  - To avoid cavitation onto the probe

- TQ423 withstands up to 100 bar



Runner clearance

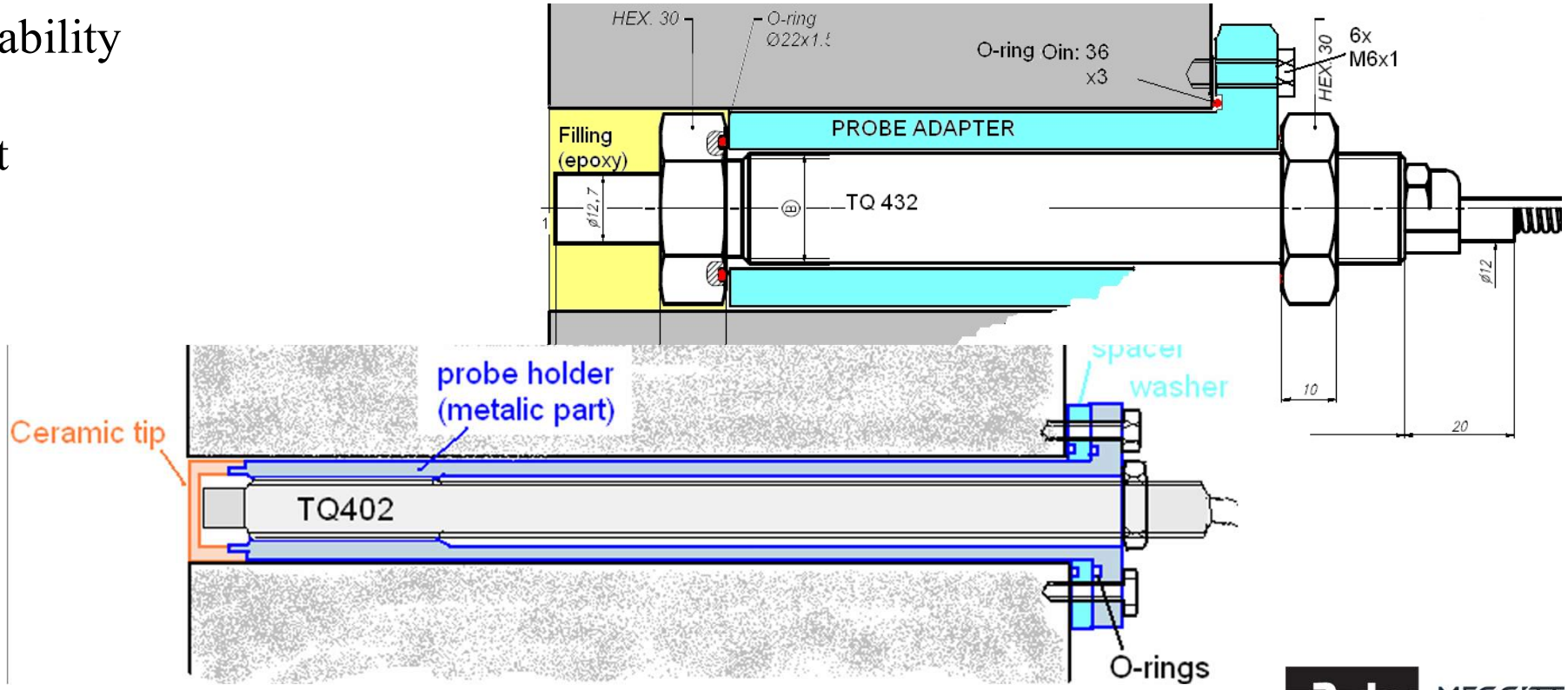
- Challenge: Pressure, cavitation, wear, calibration

Not in ISO 20816-5

- Displacement: in high water pressure
- Probe holder . ++

Interchangeability

Silt resistant



Runner clearance

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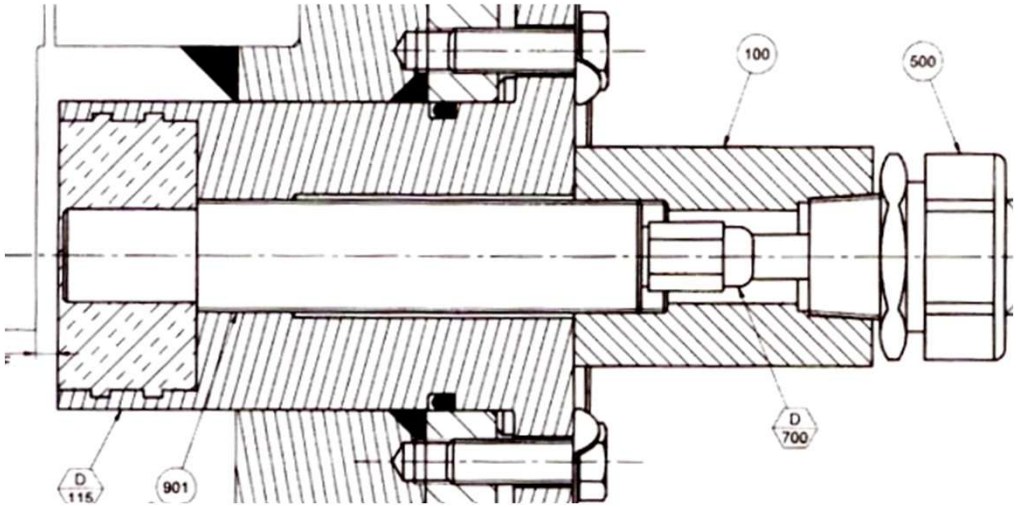
- Probe holder . ++

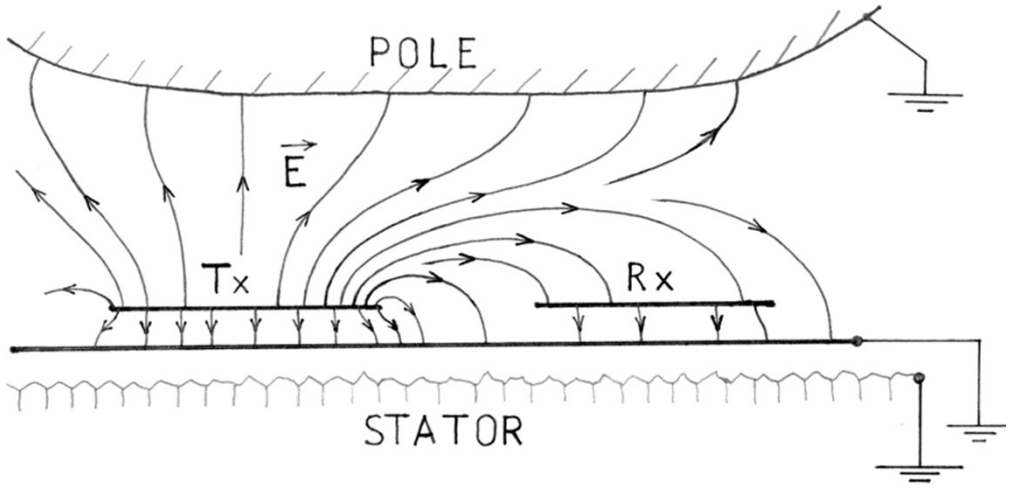


Generator Airgap

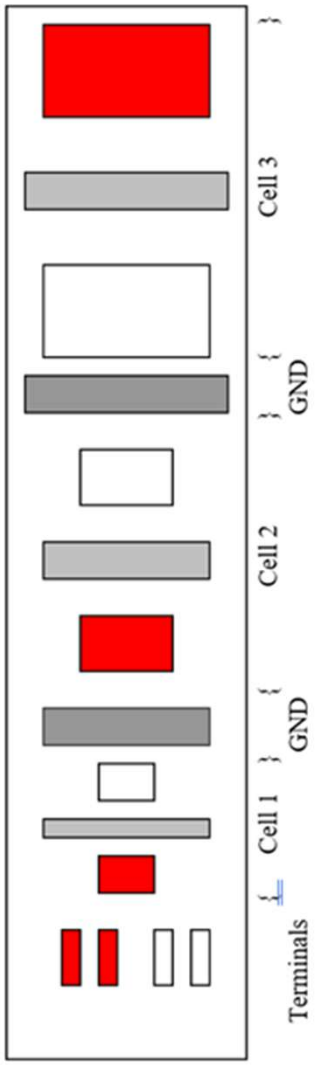
- Challenge: competition !

- LS120-121

- 3x



- Capacitive or not?

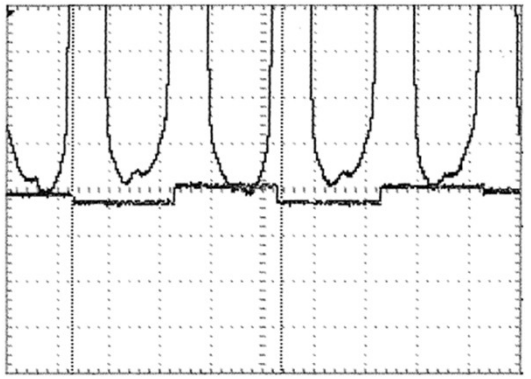


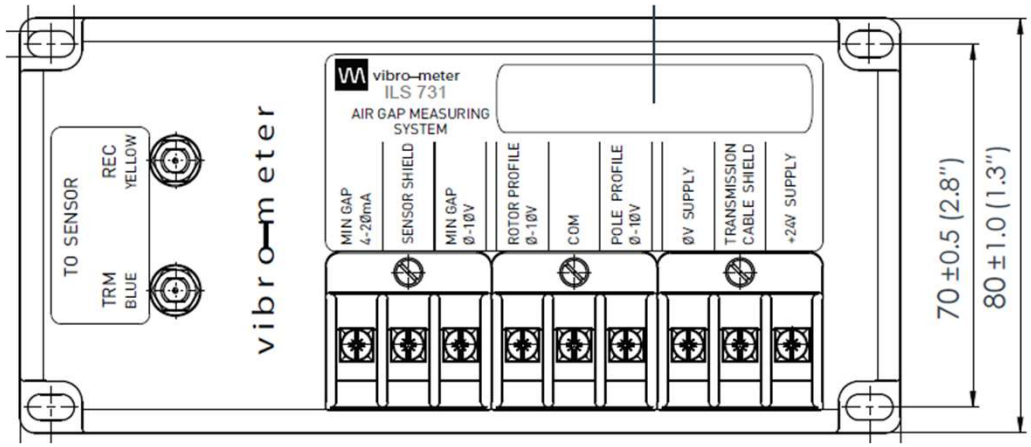
Generator Airgap

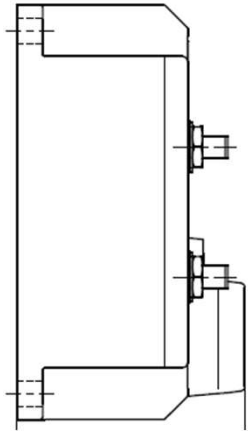
- Challenge: competition !

Why LS120-121?

- Naturally linear
- Naturally real-time
- Min-gap as 4..20mA: native in LS730







Generator Airgap

- Challenge: competition !

- Why LS120-121?
- How many sensors?

Rotor Diameter	< 7 m	7 to 10 m	10 to 13 m	> 13 m
Recommended Number of sensors	**4**	**6**	**8**	**12**
Circumferential distance	… 5.5m	3.6m 5.3m	4m 5.1m	3.4m …
Overall spatial sampling	3.4 m .. 5.5 m			

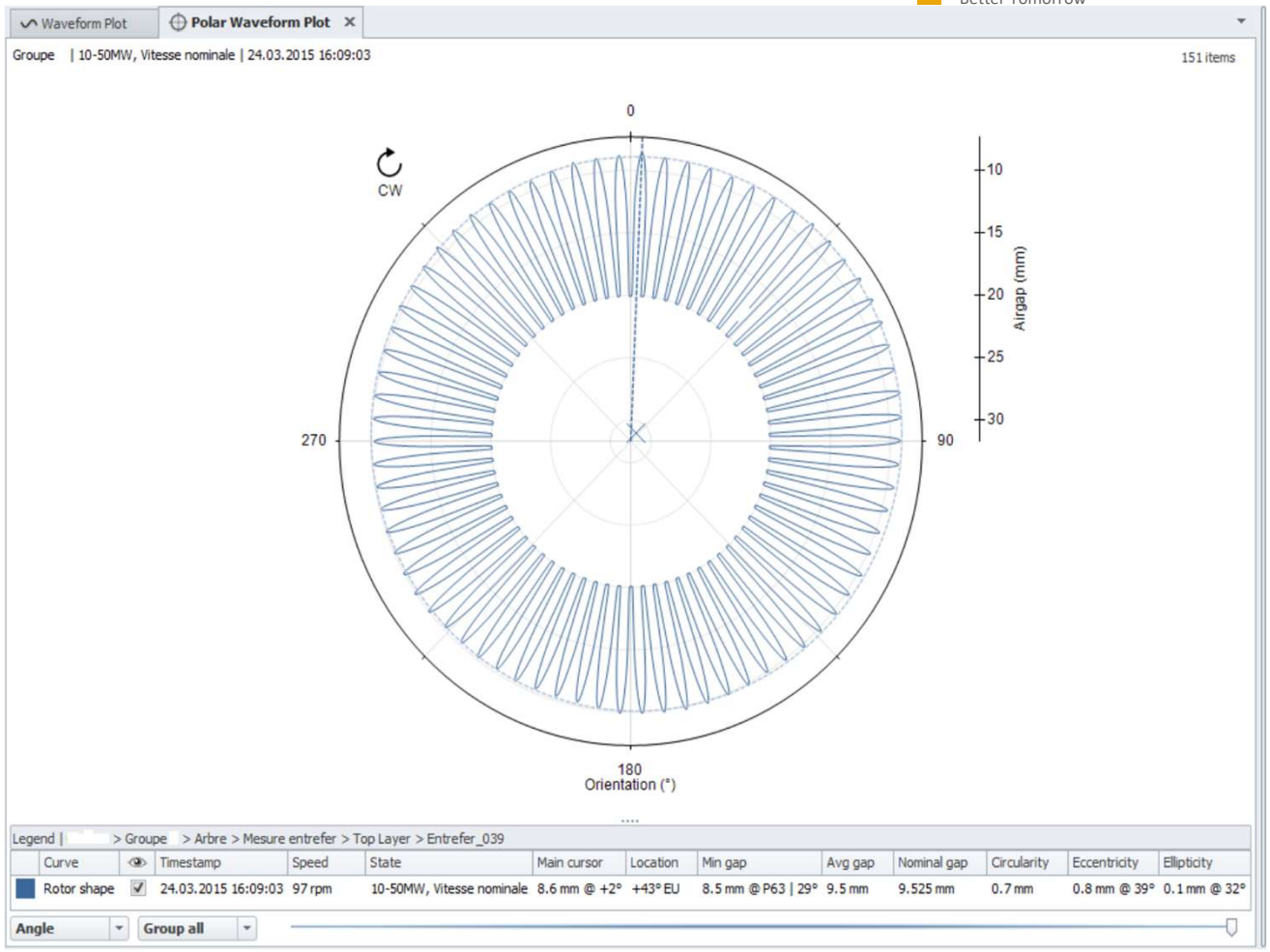
- Sensitive to grounding
  - Glue for high temperature: EPOTEK

Generator Airgap

- Challenge: competition !

Why LS120-121:

- Extremely good processing in VibroSight®

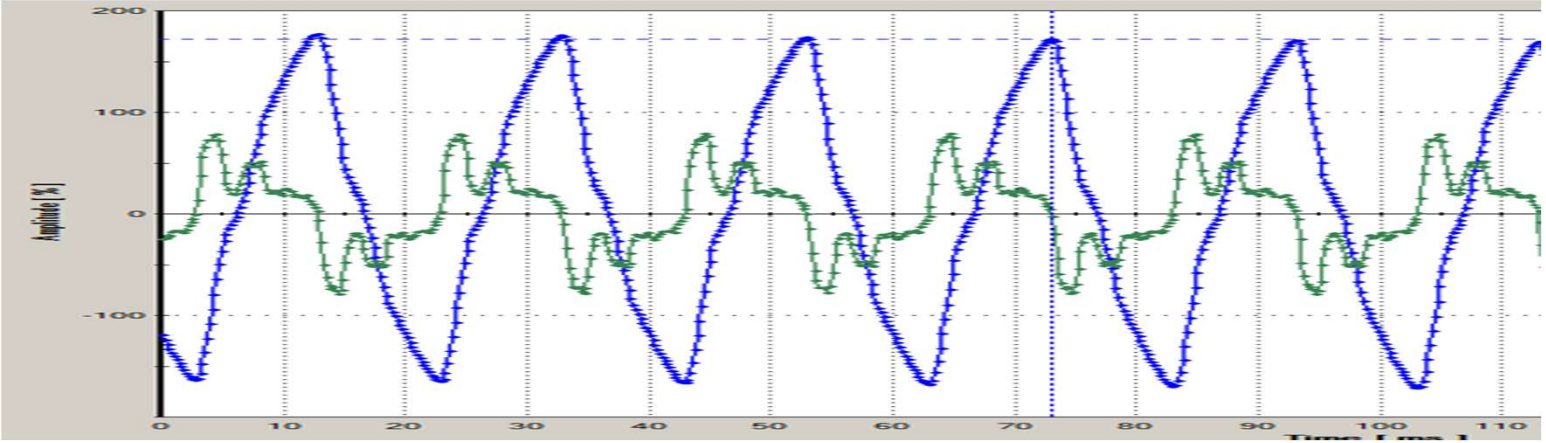


Generator Magnetic flux

- Challenge: tradition !

Inductive loop

- High signal level
- Derivative of ↔H
- Automatic processing in VibroSight®



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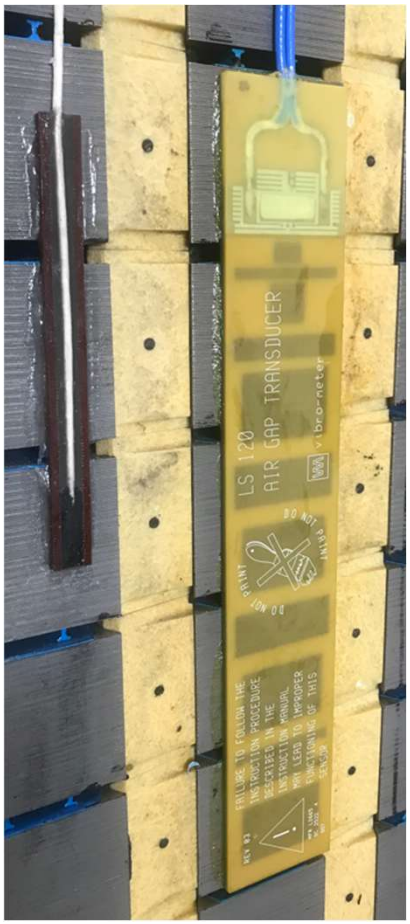
Generator Magnetic flux

- Challenge: tradition !

Hall effect sensor

- Gives directly ↔H
- Care for installation
- Third party product



Generator Magnetic flux

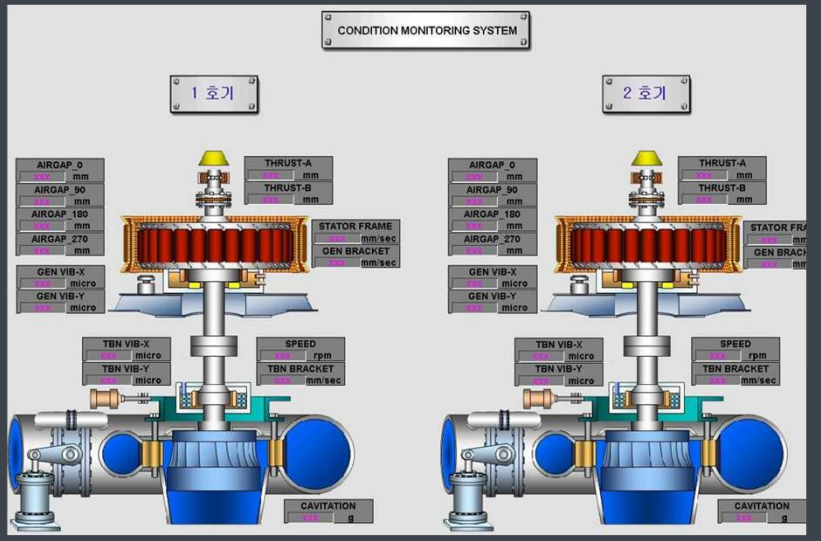
- Challenge: tradition !

Generator Accelerometer

- Unsensitive to ↔ H
- Optical technology
- Care for installation
- A third party product

Conclusion

Best Sensor in category
(except for 2 sensor categories)
With VM600 and VibroSight



→ <u>Complete system</u>

- Reputation is an asset

THANK YOU