

MEASUREMENT OF DYNAMIC WHEEL LOAD DISTRIBUTIONS

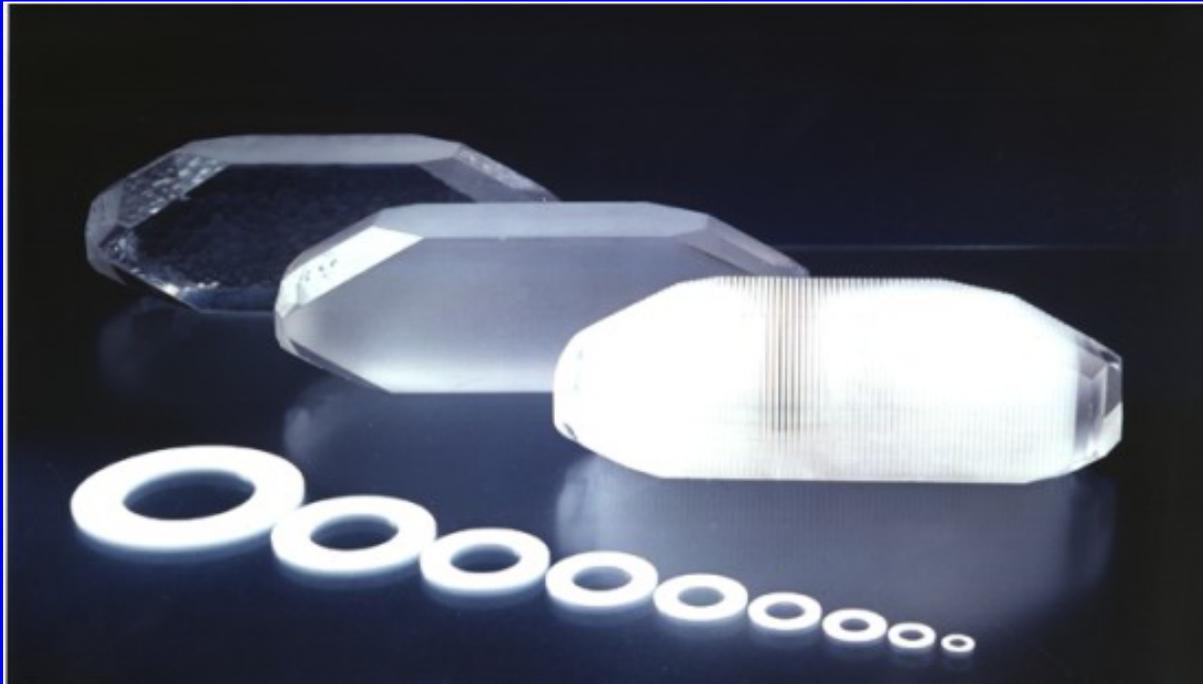
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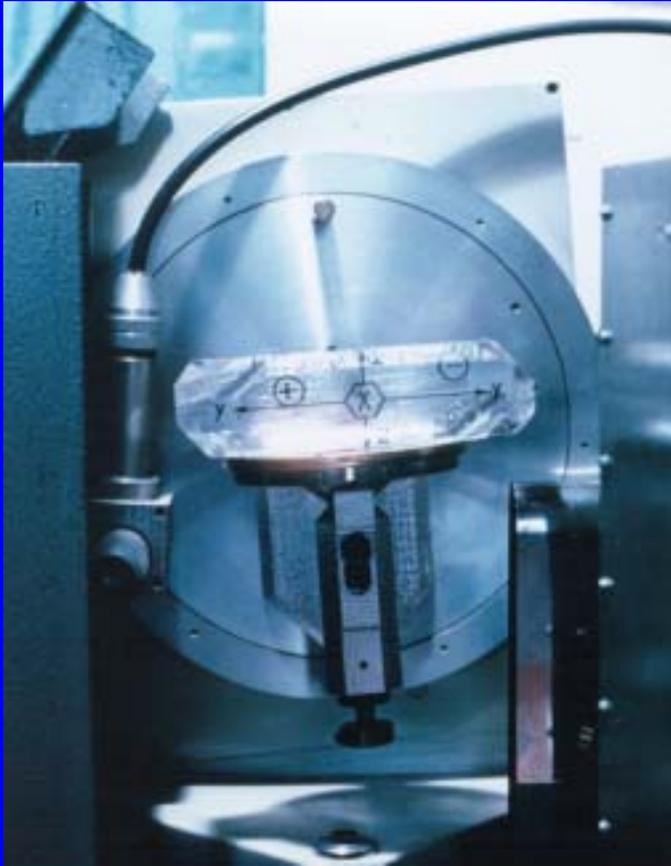
Swiss Federal
Research Station for
Agricultural
Economics and
Engineering

Quartz: Raw Material Quartz (Silicon-dioxide, SiO₂)

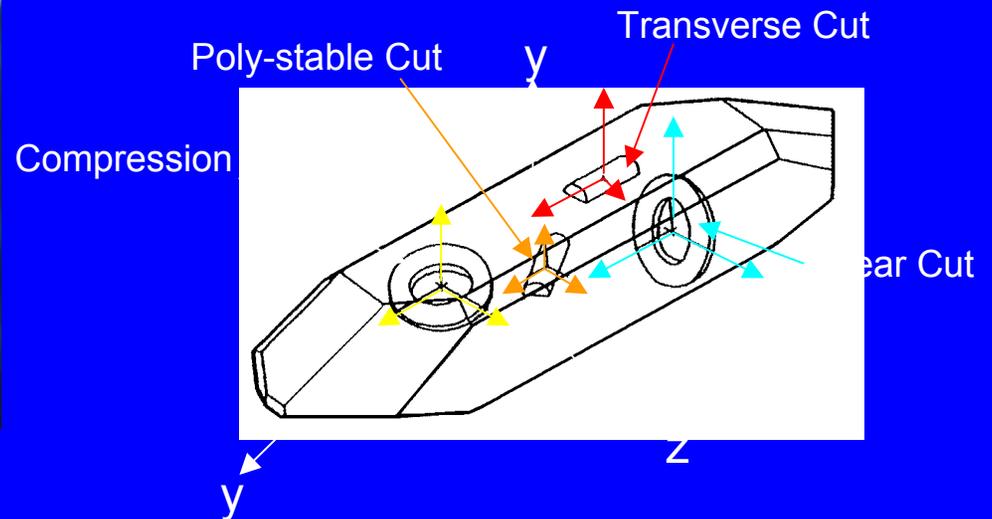


- Quartz ingots are grown in autoclaves at a pressure of 1000 bar and a temperature of 400 °C
- It takes over one week to grow a quartz ingot of about 1kg

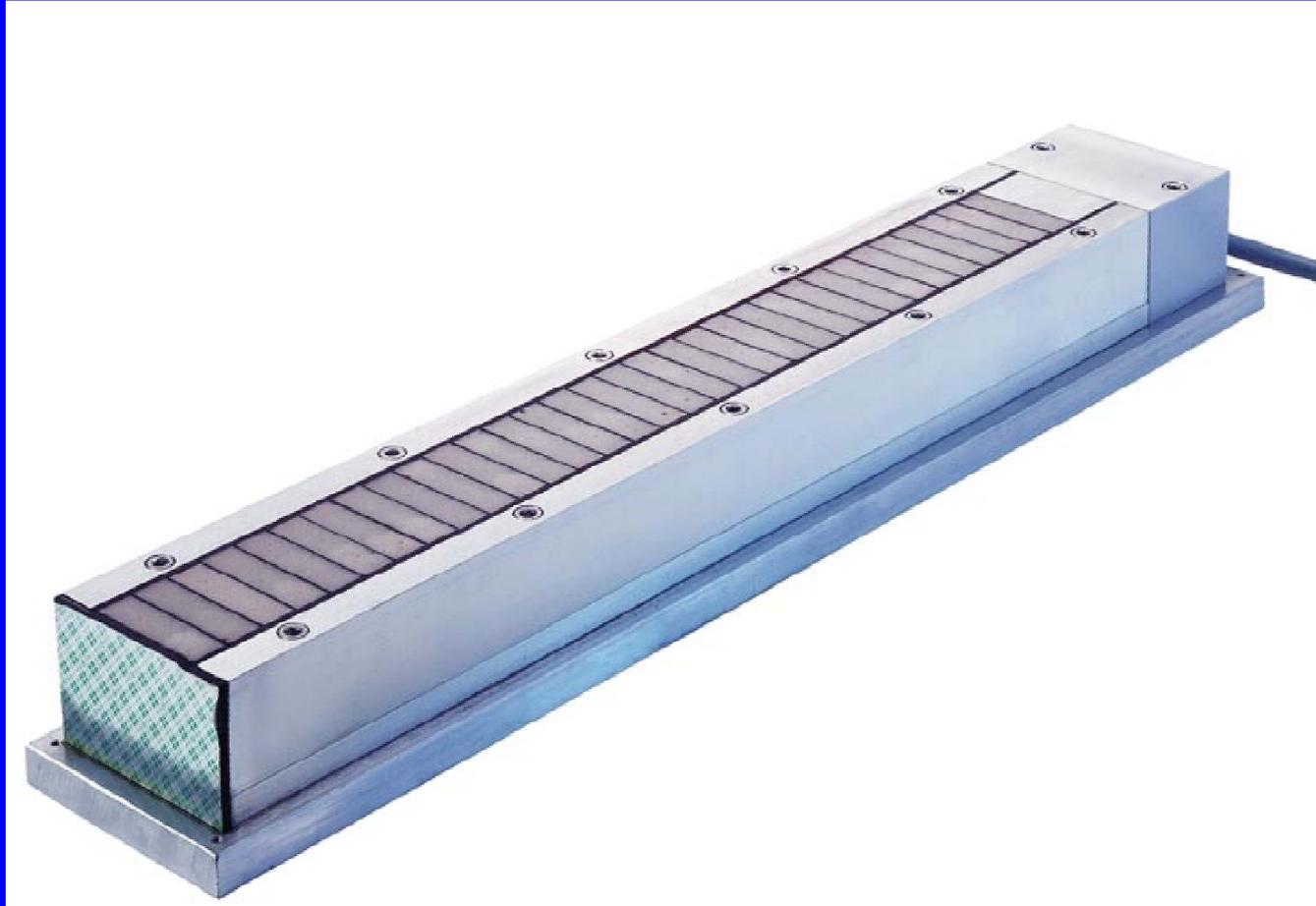
Quartz



Prior to cutting, an x-ray goniometer is used to determine the orientation of the crystal axes.



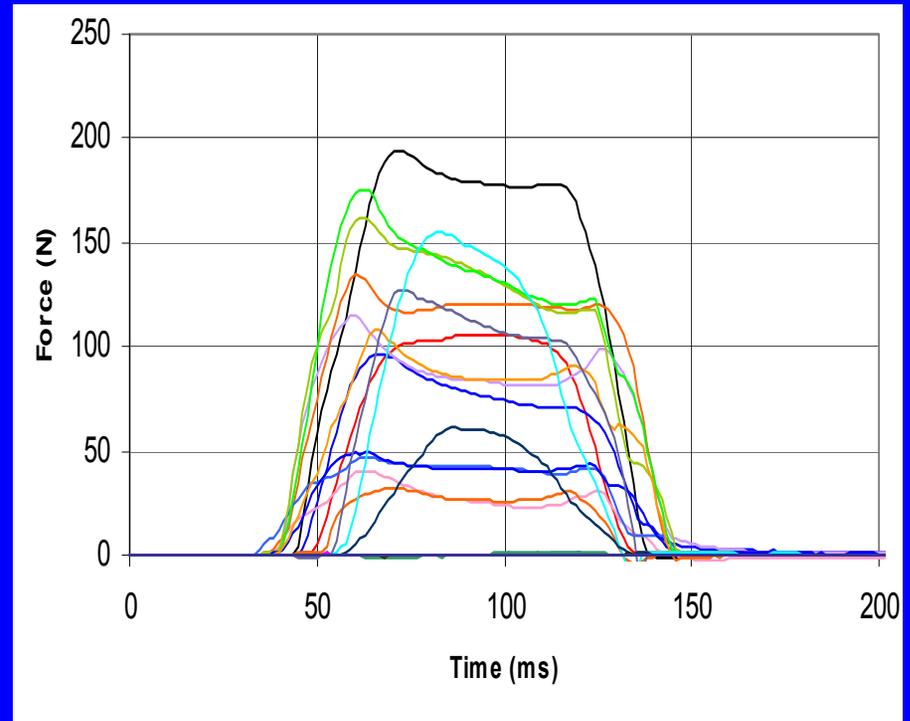
MODULAS Quartz Sensor



Scope of Measurement



Force Signals per channel



Wheel load evaluation

$$F_{\text{Gmod}} = \sum_1^{32} \left(\frac{v}{L_s} \cdot \int F(t) \cdot dt \right)$$

v: speed

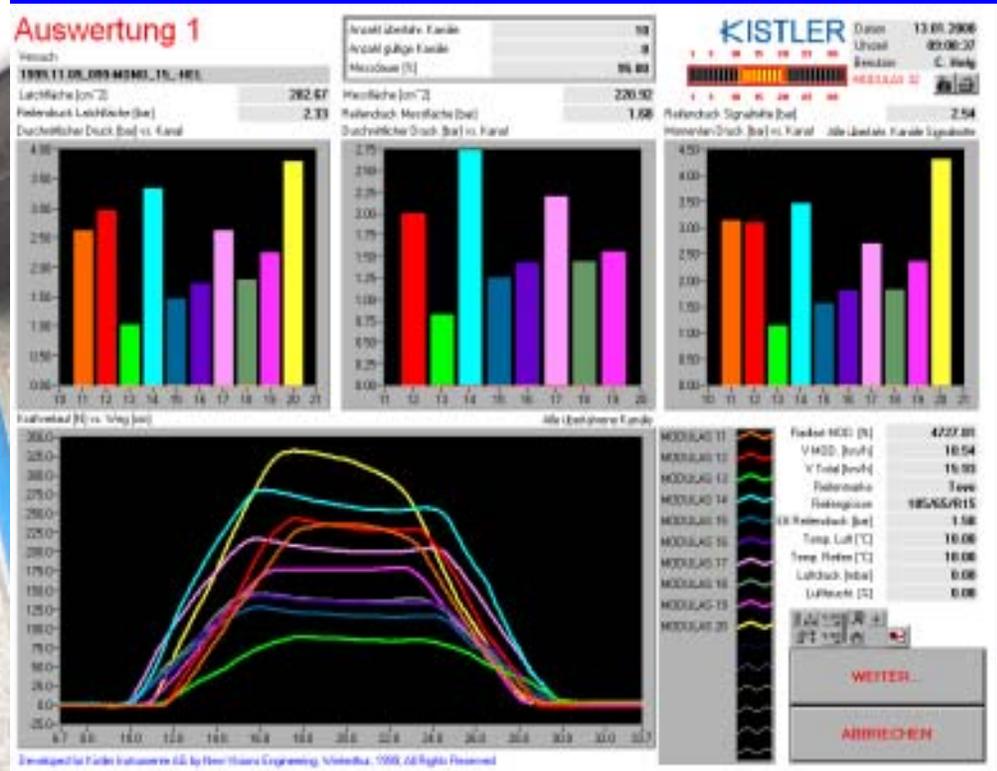
L_s : sensor length 0.05m

$F(t)$: Force process per channel

$$\sum_1^{32}$$

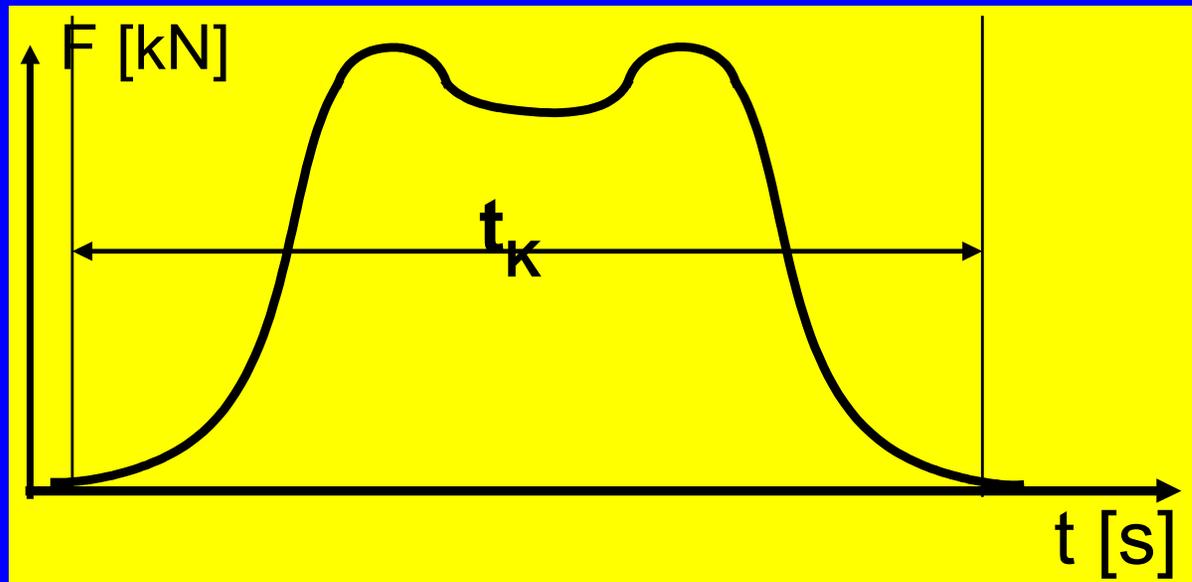
Summ over all 32 channels

Contact pressure distribution



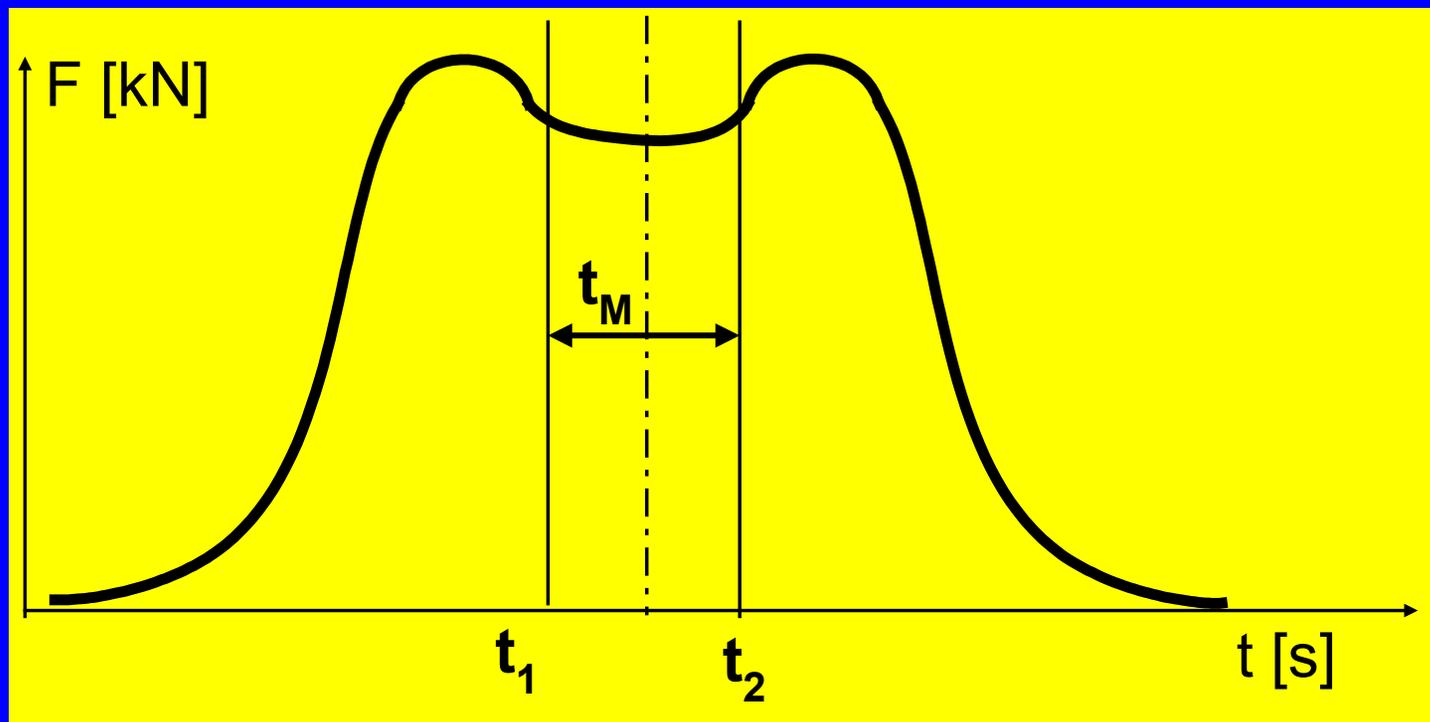
Latch area

$$A_L = \sum_1^{32} (v \cdot t_K \cdot B_S) = v \cdot B_S \cdot \sum_1^{32} t_K$$



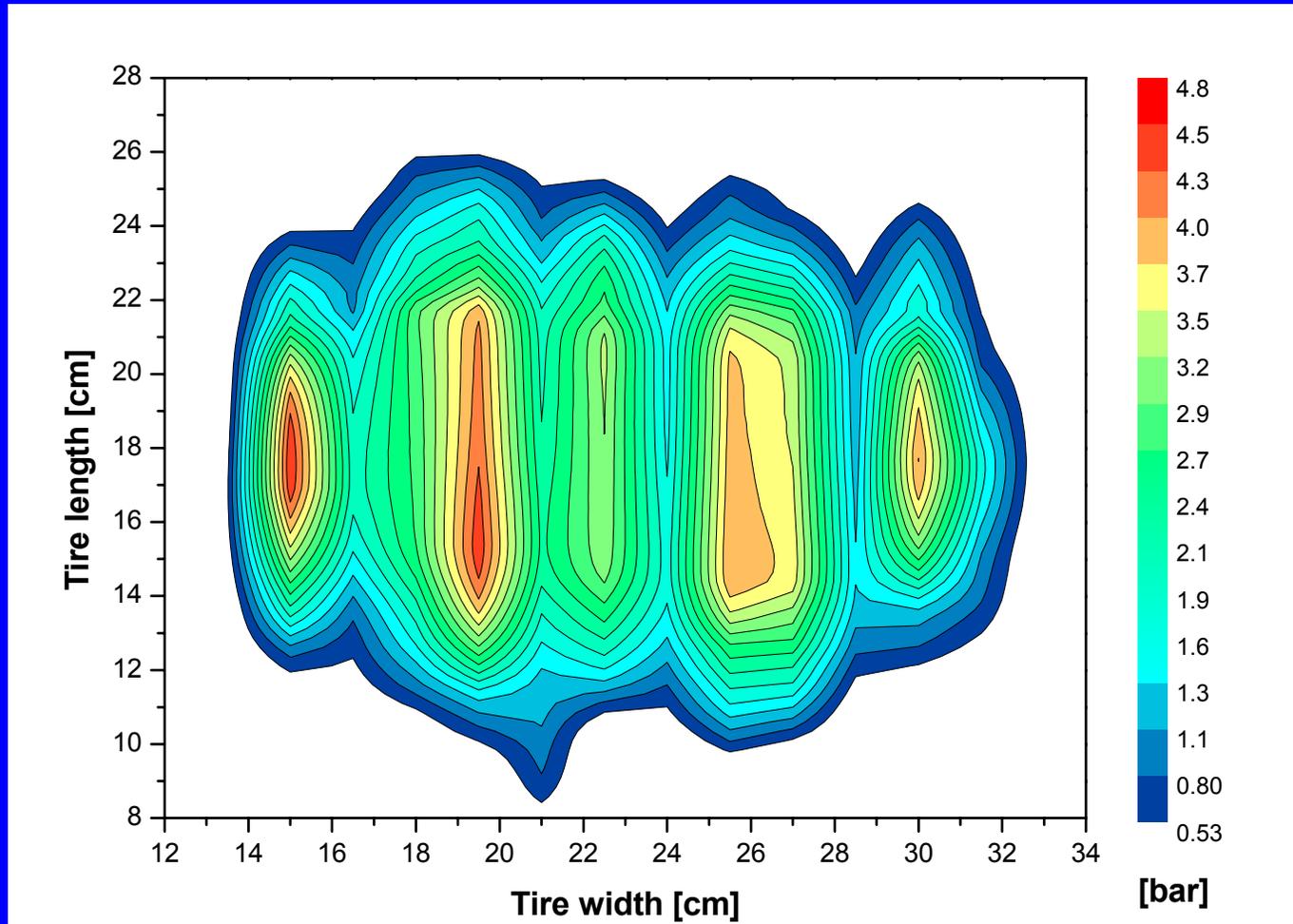
Measuring area

$$A_M = \sum_n^m (v \cdot t_M \cdot B_s) = v \cdot B_s \cdot \sum_n^m t_M$$

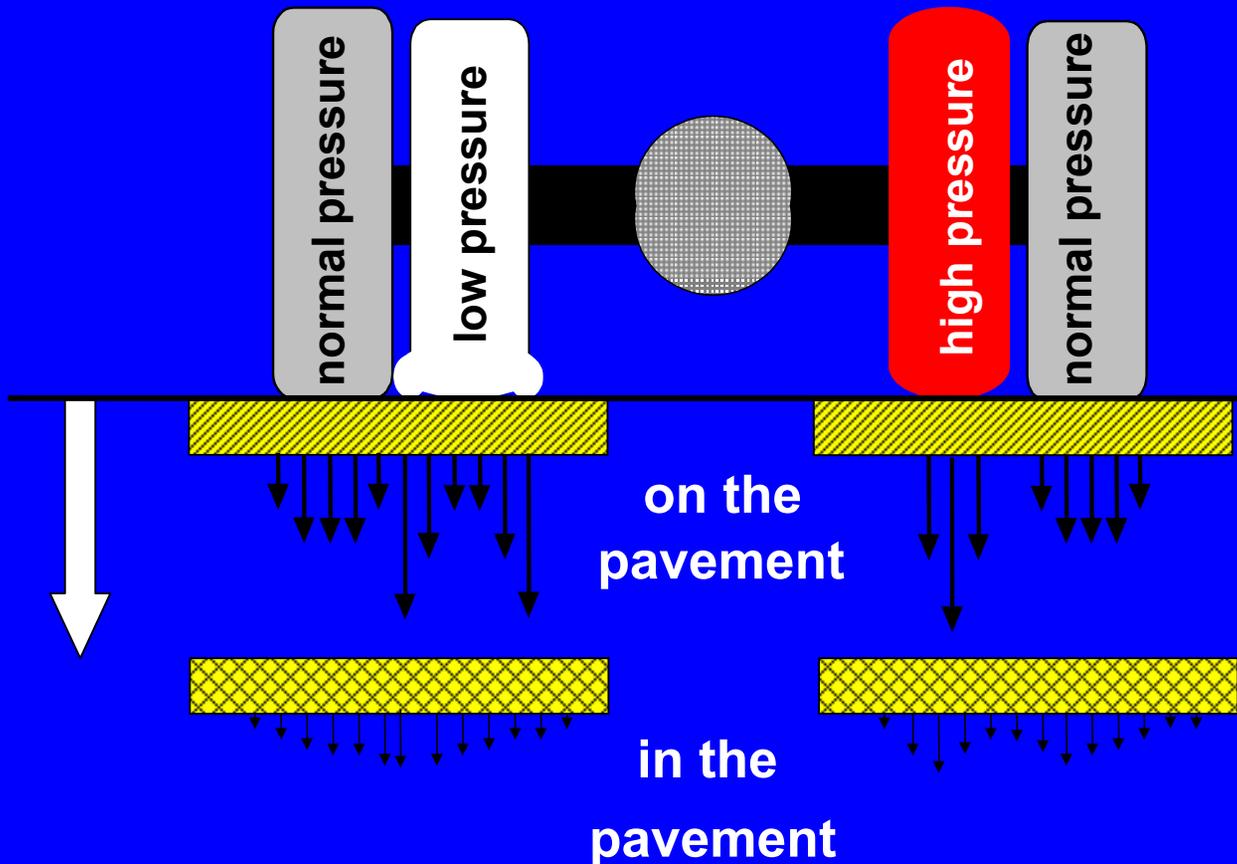


Tire - Road - Interaction

Wheel Load Distribution: Contact Pressure between Tire and Road



Force Distribution Between Tire and Pavement



Performance & Advantages

- **Quartz sensing element - stability of electrical and mechanical characteristics, almost insensitive to temperature changes**
- **Temperature range: -30 °C to +60 °C**
- **Very clear signal: no filtering or baseline correction needed**
- **Cross-talk between channels: < 2 %**
- **Wide measuring range: from cars to heaviest vehicles**
- **Calibration per measurement channel**
- **Removable**

MODULAS Applications

- **Detection of overloaded axles or over-inflated tires**
- **Measurements of tire load distribution:
graphic representation**
- **Tire width measurements**
- **Detection of under-inflated tires:
to help preventing motorways accidents**
- **Accurate monitoring of traffic flow parameters**

Tire - Road - Interaction



Benefits for the Road Operator

- To optimize dimension methods for pavement and road constructions
- Reduce maintenance work
- Achieve cost savings
- Increase Road safety

Pavement Research



- Pressure Distribution
- Dynamic Wheel Load
- Footprint Dimensions
- Distinction between Double and Single or Super-Single Tires
- Wheel-path Position
- Influence on Rut- and Crack Formation

Measuring of Wheel Load Distribution in Sub-base

- **FAT Tjänkon - Agrotechnical Research**
- **Stress and Compression measuring**



Force Distribution Measurement Function of Depth



Application: Force Distribution Measurement in Function of Depth



For your personal questions
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