
Pressure Indication of Expansion Devices

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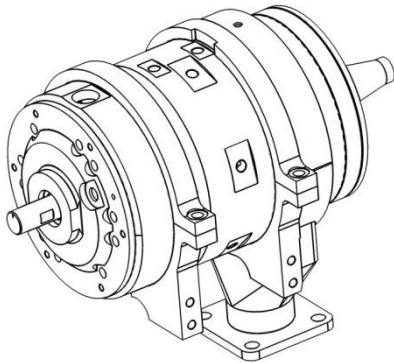
Friday, September 27th, 2013



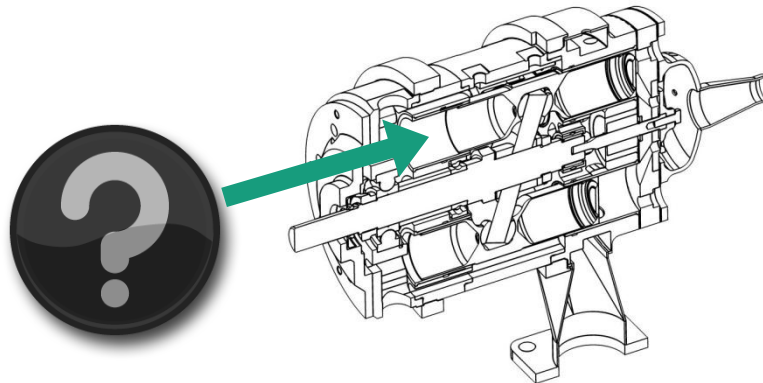
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Motivation



$$\eta_{Exp} = \frac{P_{eff}}{\dot{m}_{WF} \cdot \Delta h_{is}}$$



P_{ind}
 P_{eff}
 P_{fr}
 i_{mep}
 e_{mep}
 f_{mep}
 p_{Cyl}

η_{Exp}

$$\eta_{Exp,ind} = \frac{P_{ind}}{\dot{m}_{WF} \cdot \Delta h_{is}}$$

$$\eta_{Exp,mech} = \frac{P_{fr}}{\dot{m}_{WF} \cdot \Delta h_{is}}$$

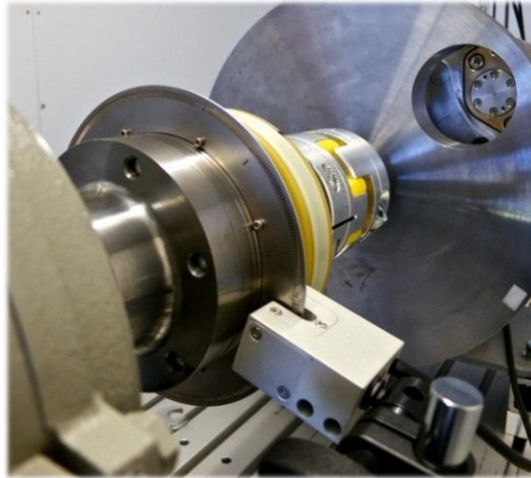
➡ Gain knowledge of the expansion process

➡ Surveillance and analysis of engine valve timing and pipe dimensioning

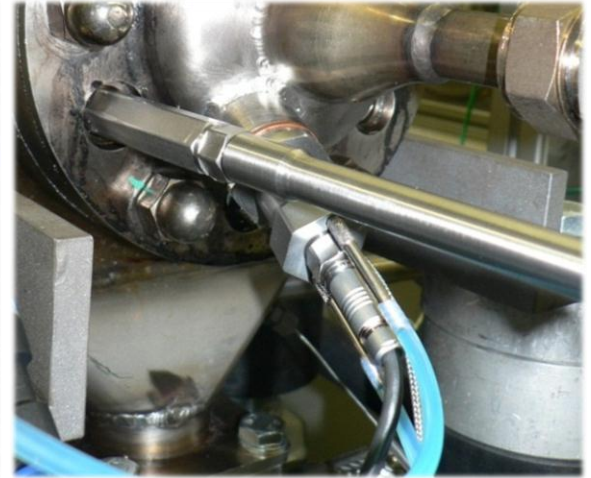
Components required for indicating



Pressure transducer



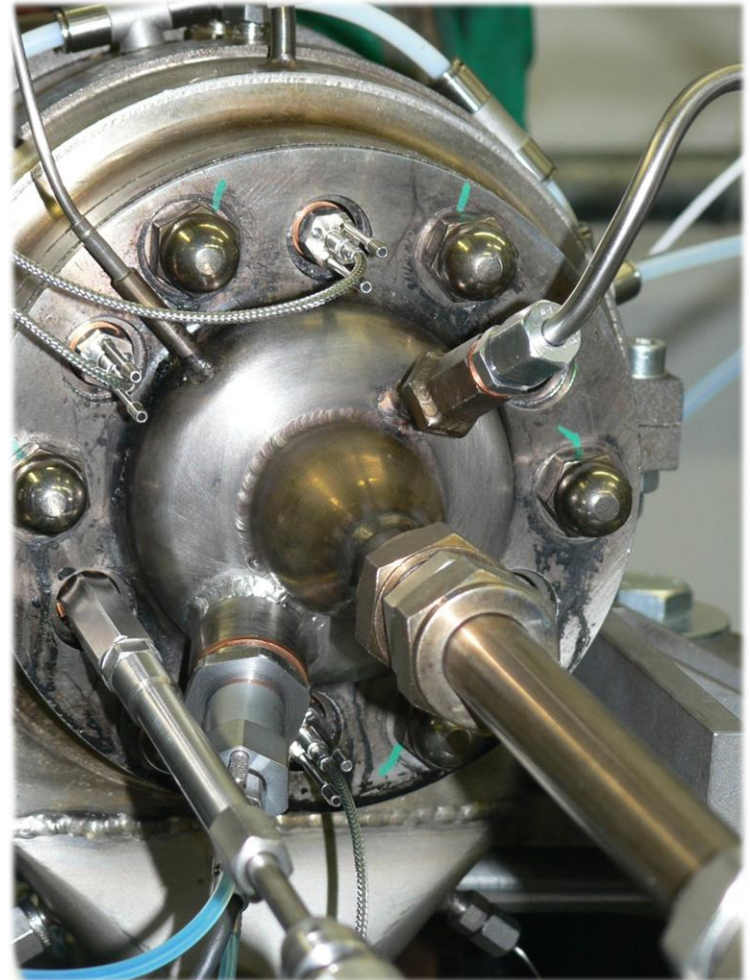
Rotation-angle measurement



TDC-Determination

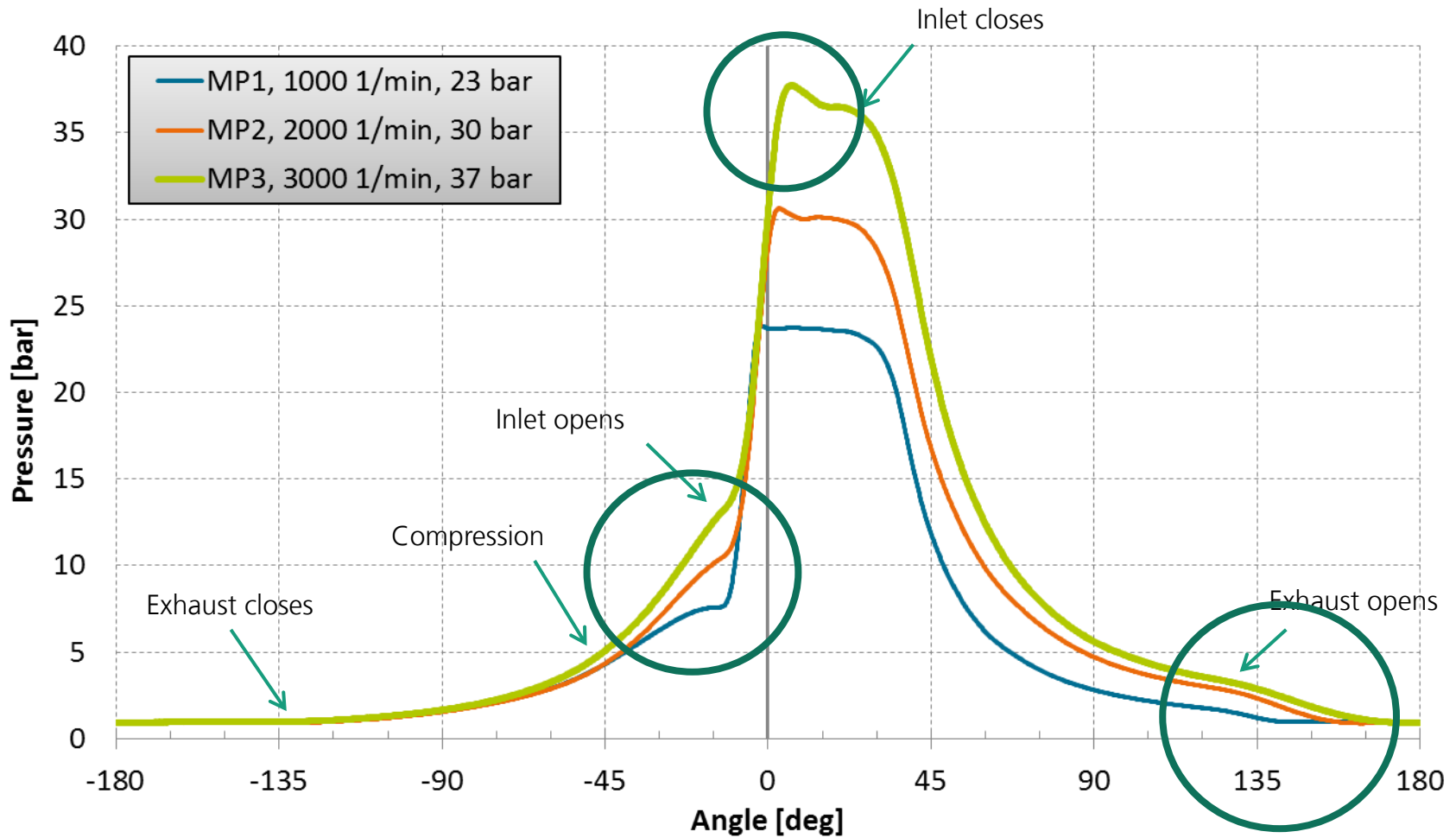
Axial-piston expander

- Measurement technology for indicating:
 - Piezoelectric pressure transducers
 - Piezoresistive pressure transducers
 - TDC-Sensor (capacitive)
 - Rotation-angle sensor
- Positioning of the Indicating-bores



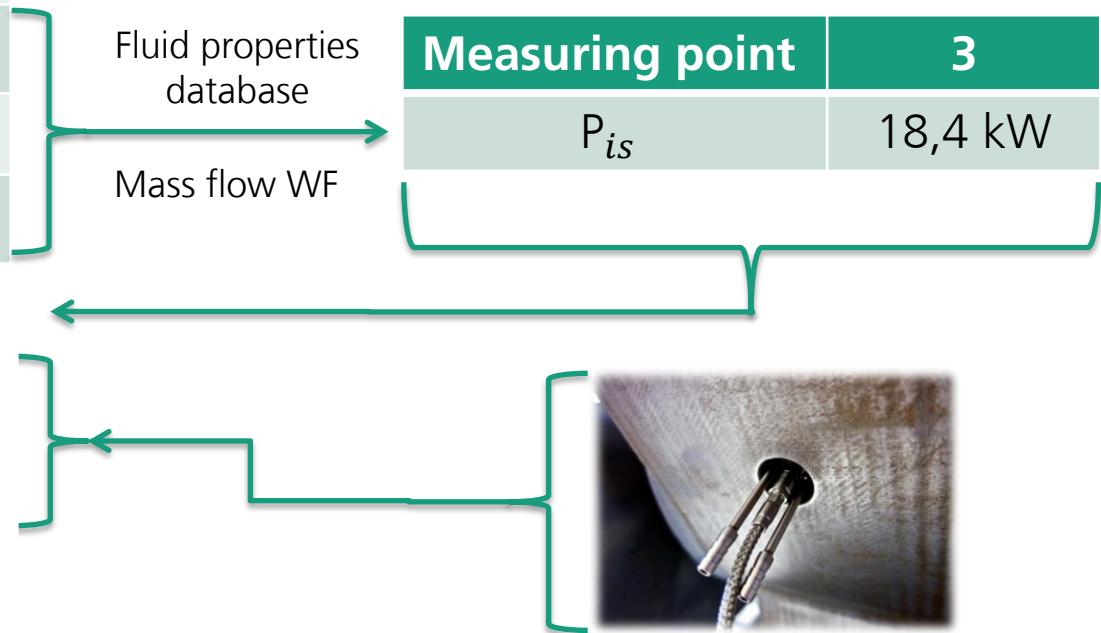
Axial-piston expander

p,RA-diagram



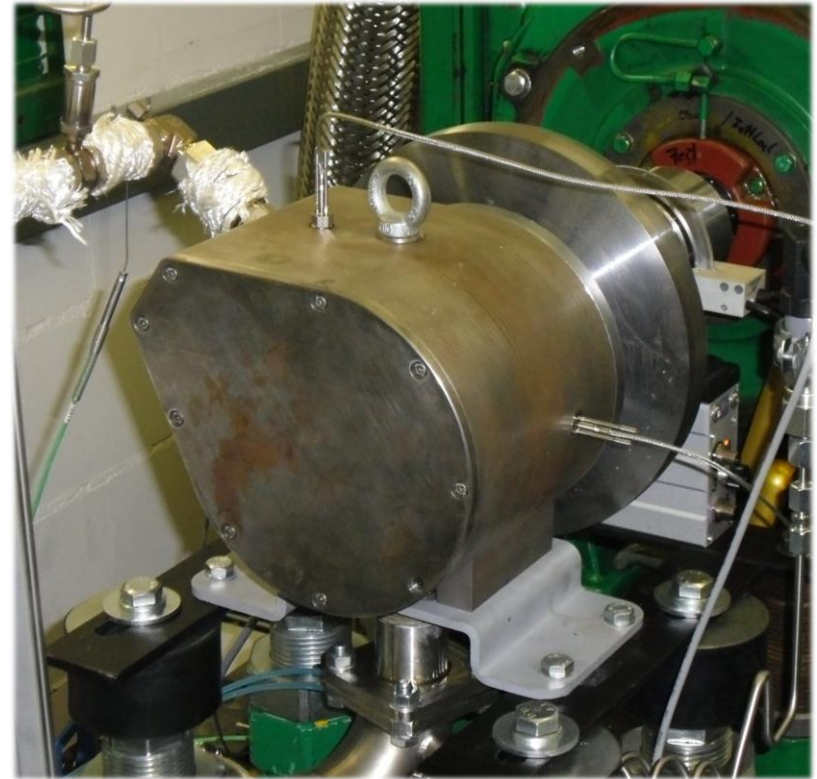
Axial-piston expander

Measuring point	3
n_{Exp}	3000
P_{Eff}	4,6 kW
$p_{Exp,in}$	37,2 bar
$T_{Exp,in}$	319,1 °C
$p_{Exp,ex}$	1 bar



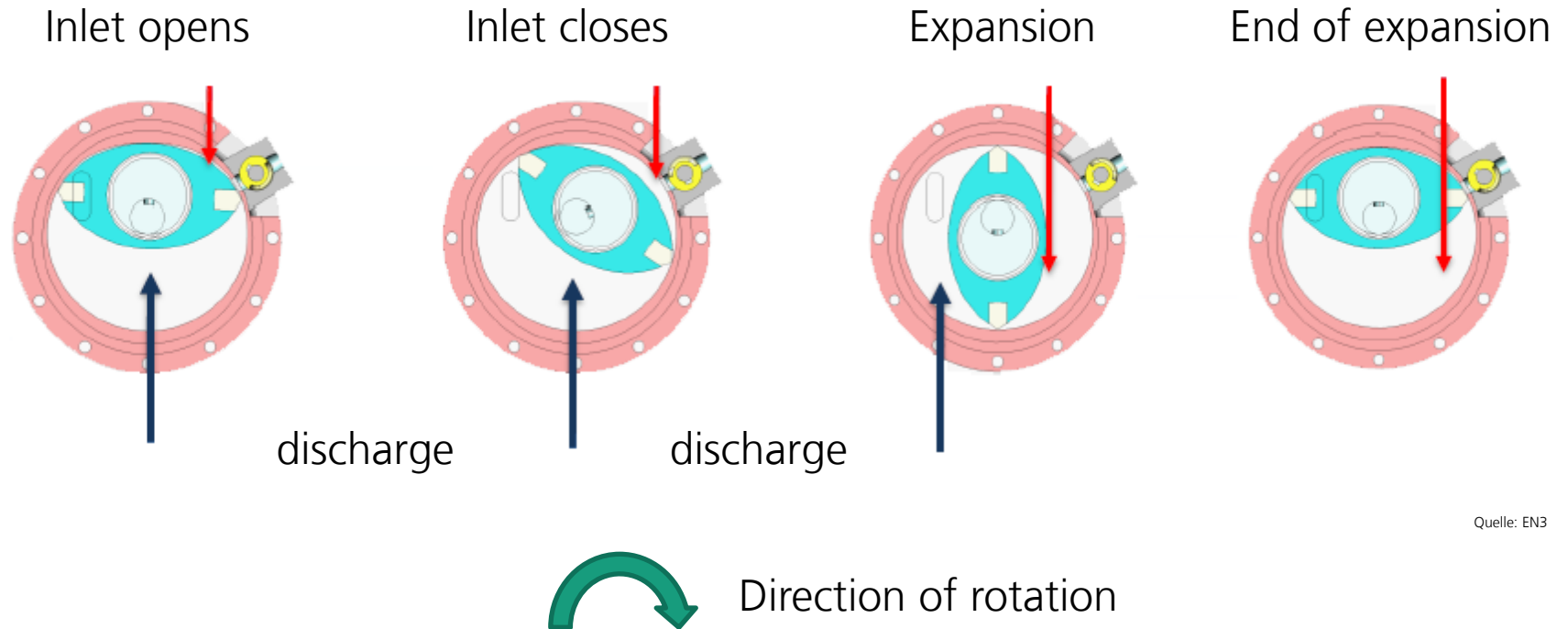
Rotary-piston expander

- Measurement technology for indicating:
 - Piezoelectric sensors
 - Piezoresistive sensors
 - Rotation-angle sensors
- Positioning of indicating-bores



Rotary-piston expander

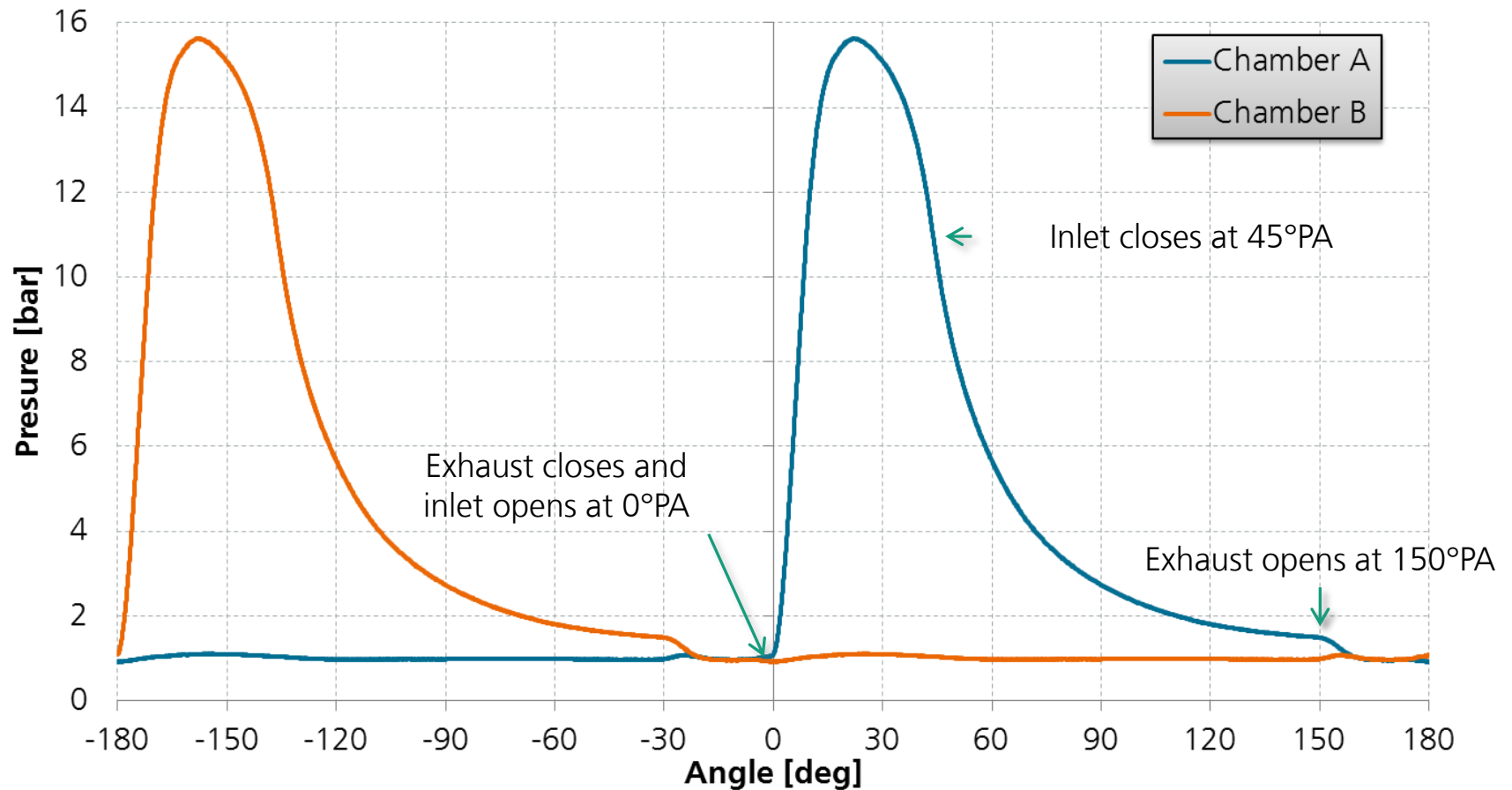
Function principle



Quelle: EN3

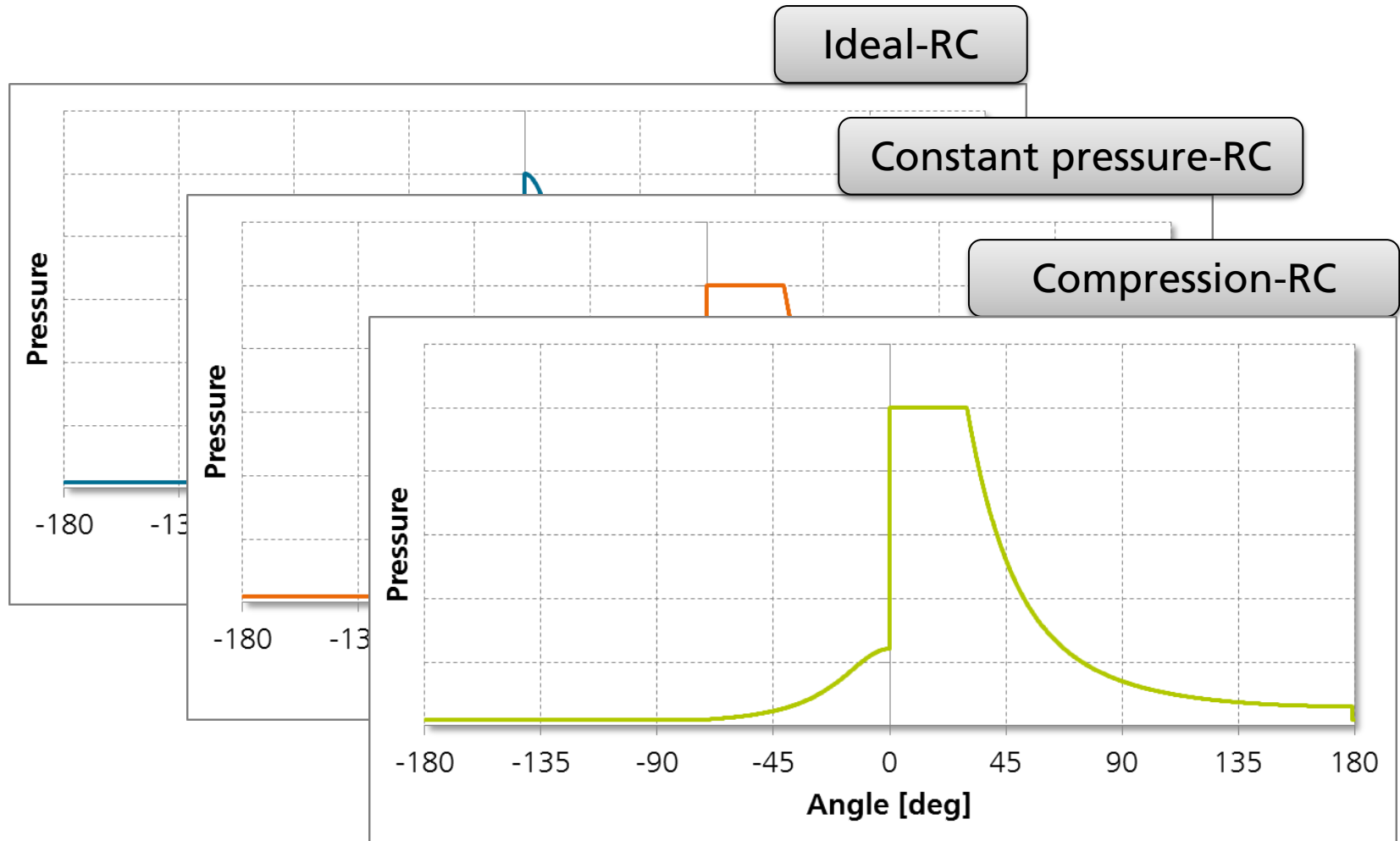
Rotary-piston expander

p,PA-diagram



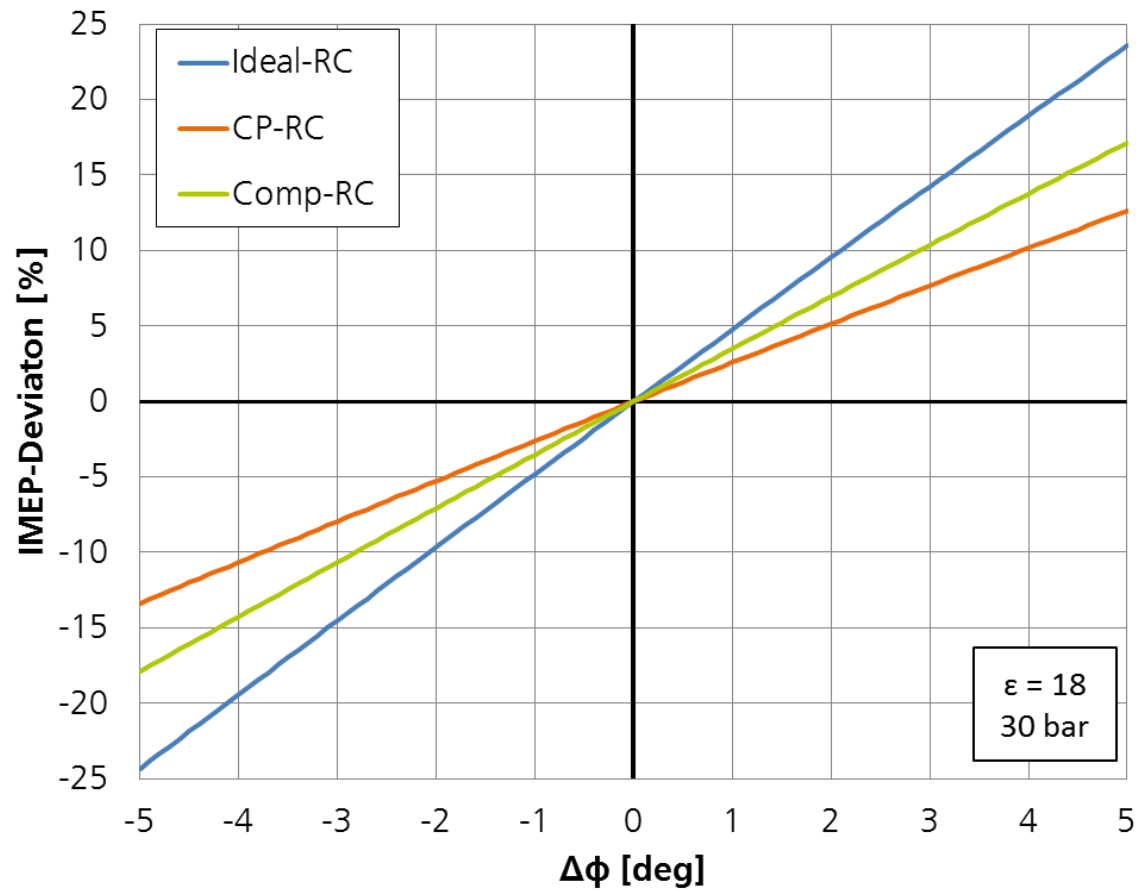
Errors affecting indicating measurements

TDC-alignment; Ideal reference cycles (RC) for expanders



TDC-Alignment

Error in IMEP-Calculation in consequence of TDC-offset



Conclusion

- Pressure indicating is a useful tool to evaluate the performance of expanders
- Create extended knowledge about internal processes of the expander
- TDC-Determination is the most common reason for errors affecting the measurement-accuracy



Pressure indicating is an essential tool in the research and development of expansion devices

Thank you for your attention!

