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Control of High Pressure: Expansion Valve and Pressure Sensor

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Control of High Pressure: Expansion Valve and Pressure Sensor

Expansion valve

- Design and function
- Throttle slot geometry
- Characteristics

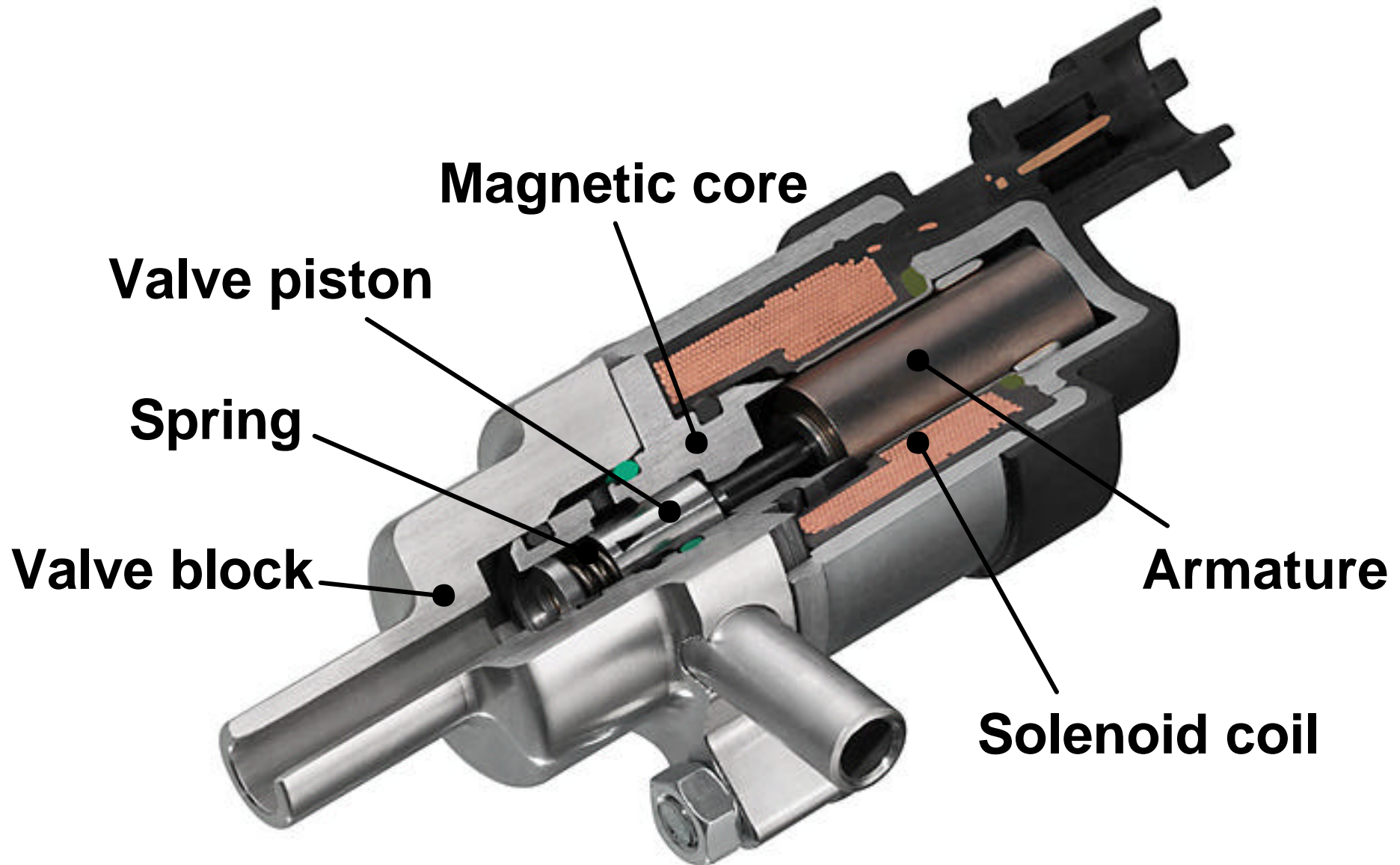
Pressure sensor

- Measuring principle
- Features
- Main requirements

Test results: Test rig and vehicle

Summary

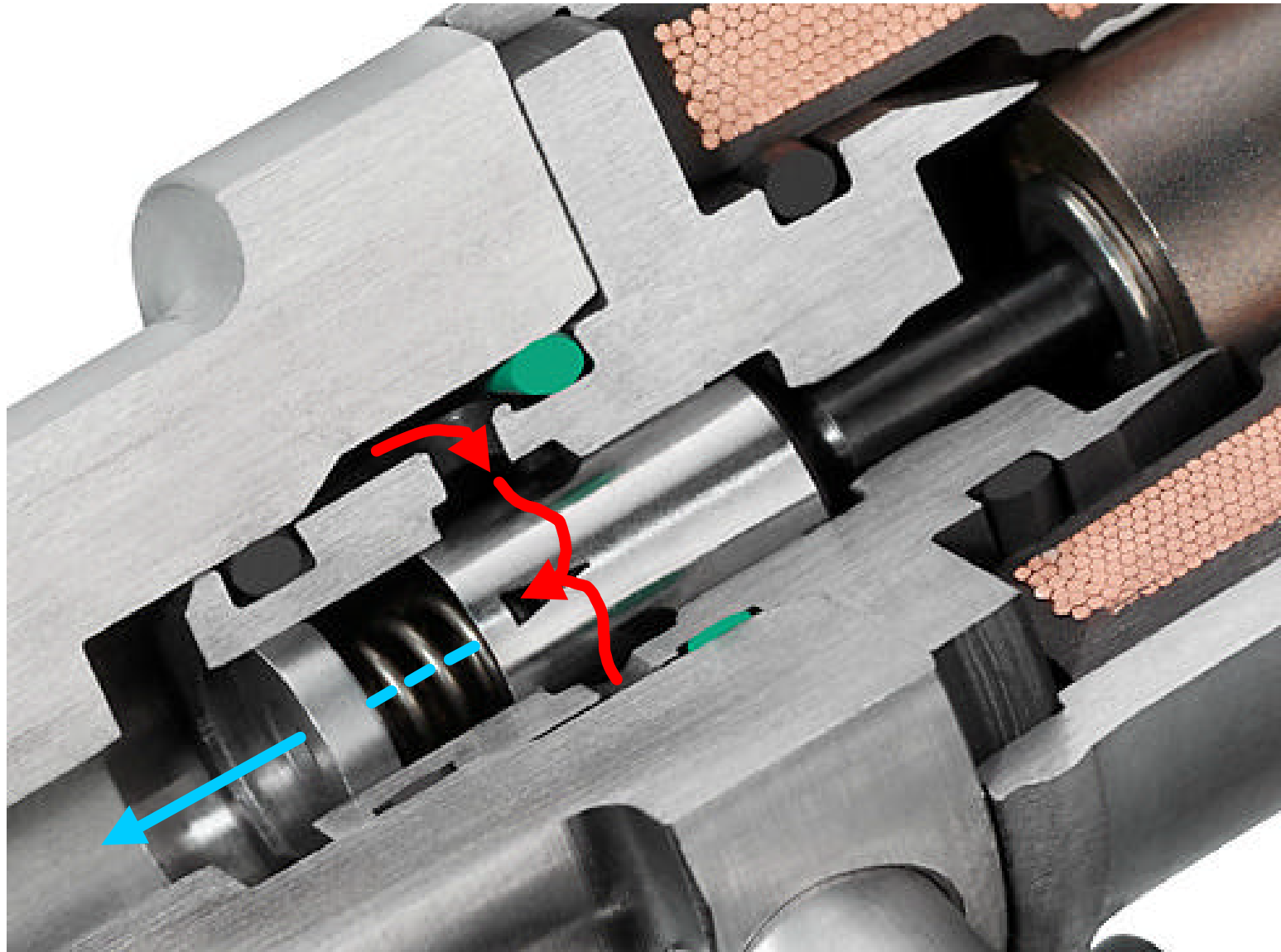






Expansion Valve

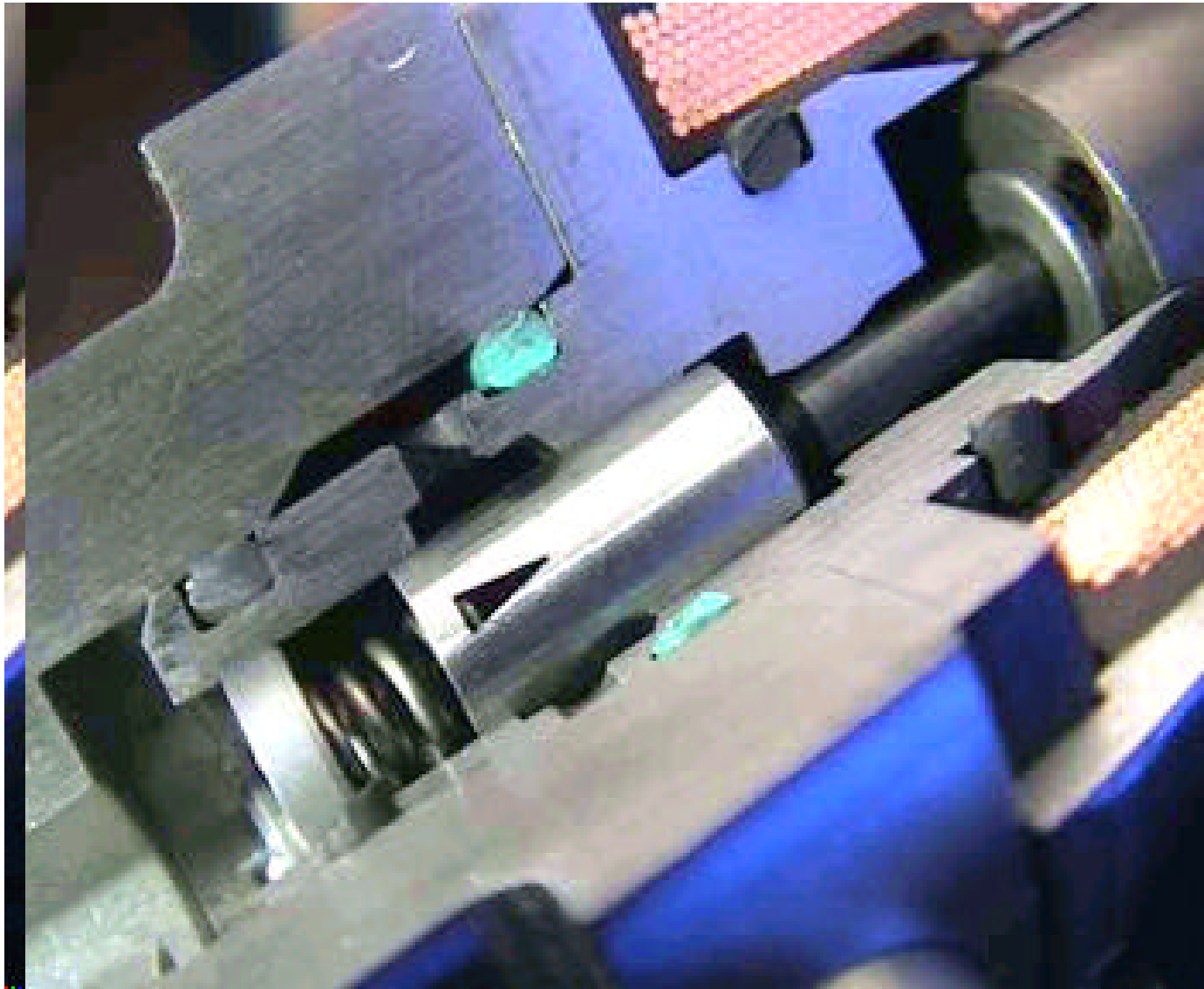
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Expansion Valve

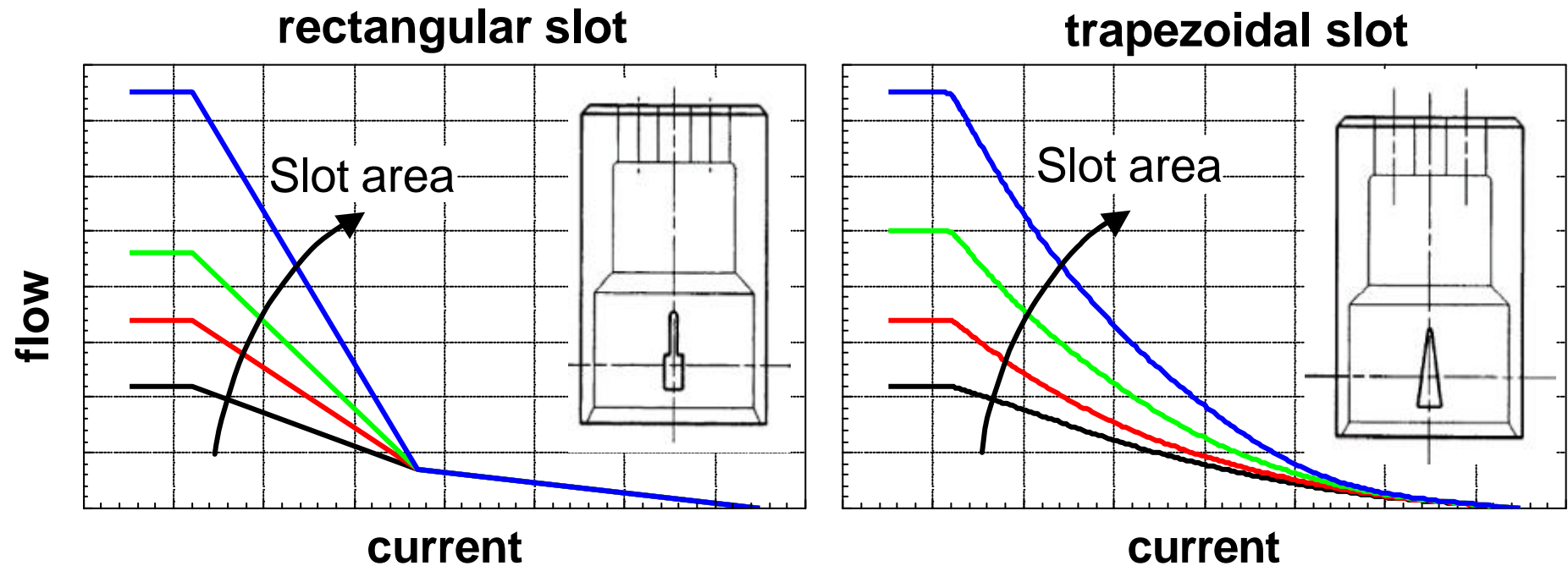
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Throttle Slot Geometry

Laser cut slot with different shapes and sizes for different flow rates and characteristics





Characteristics

- normally open
- pressure compensated
- proportional
- max. opening cross section 1.4 to 6.3 mm²
- control range 4 to 14 MPa
- burst pressure > 35.2 MPa (SAE J639 draft)
- control signal PWM, 250 to 400 Hz
- operating current 0.3 to 1.7 A
- internal leakage fully closed 2 to 10 g/s @ 12/4 MPa, 30 °C
- opening time 20 ms
- silent operation



Applications

Sensor principle used in different applications



Gasoline Direct Injection 14 MPa

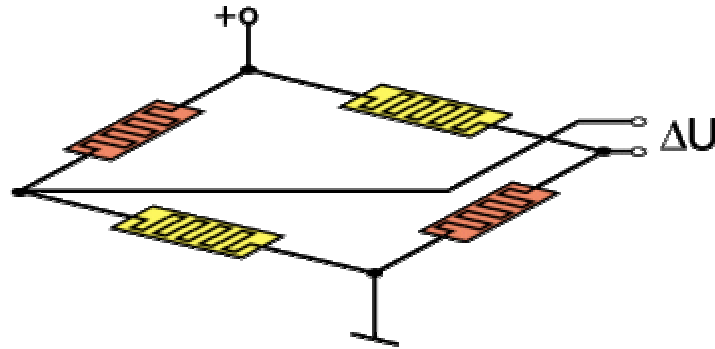


Diesel Common Rail 180 MPa

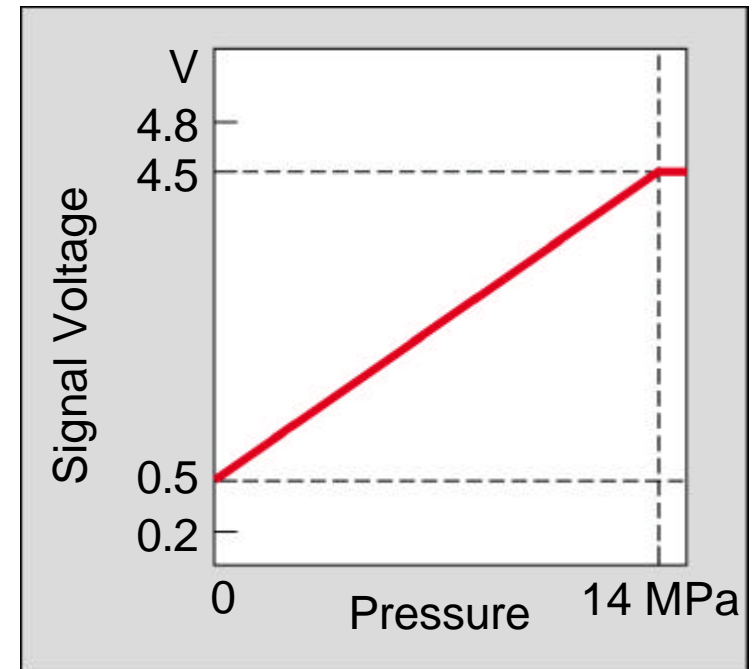
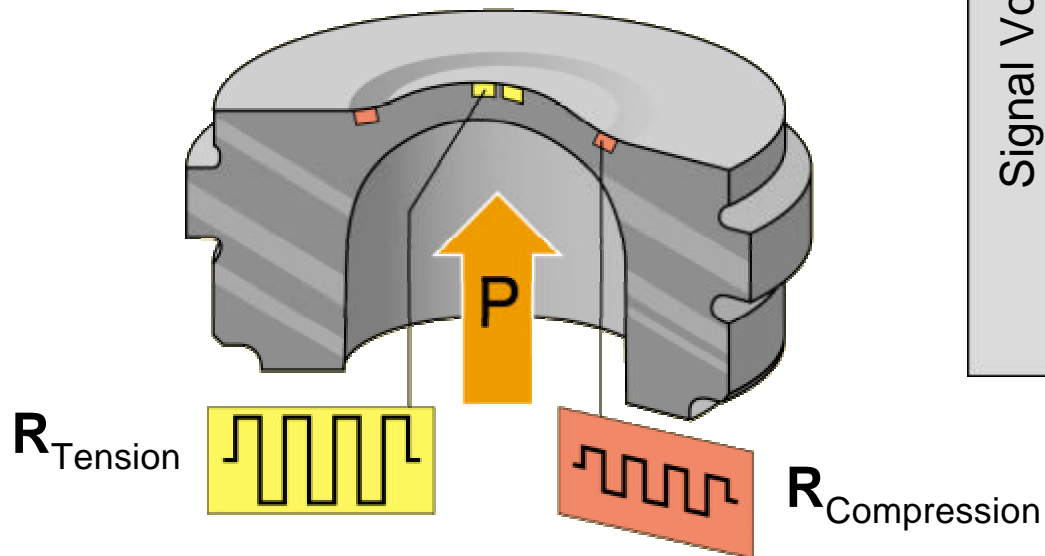
→ New Application: CO₂-Pressure Sensor



Measuring Principle

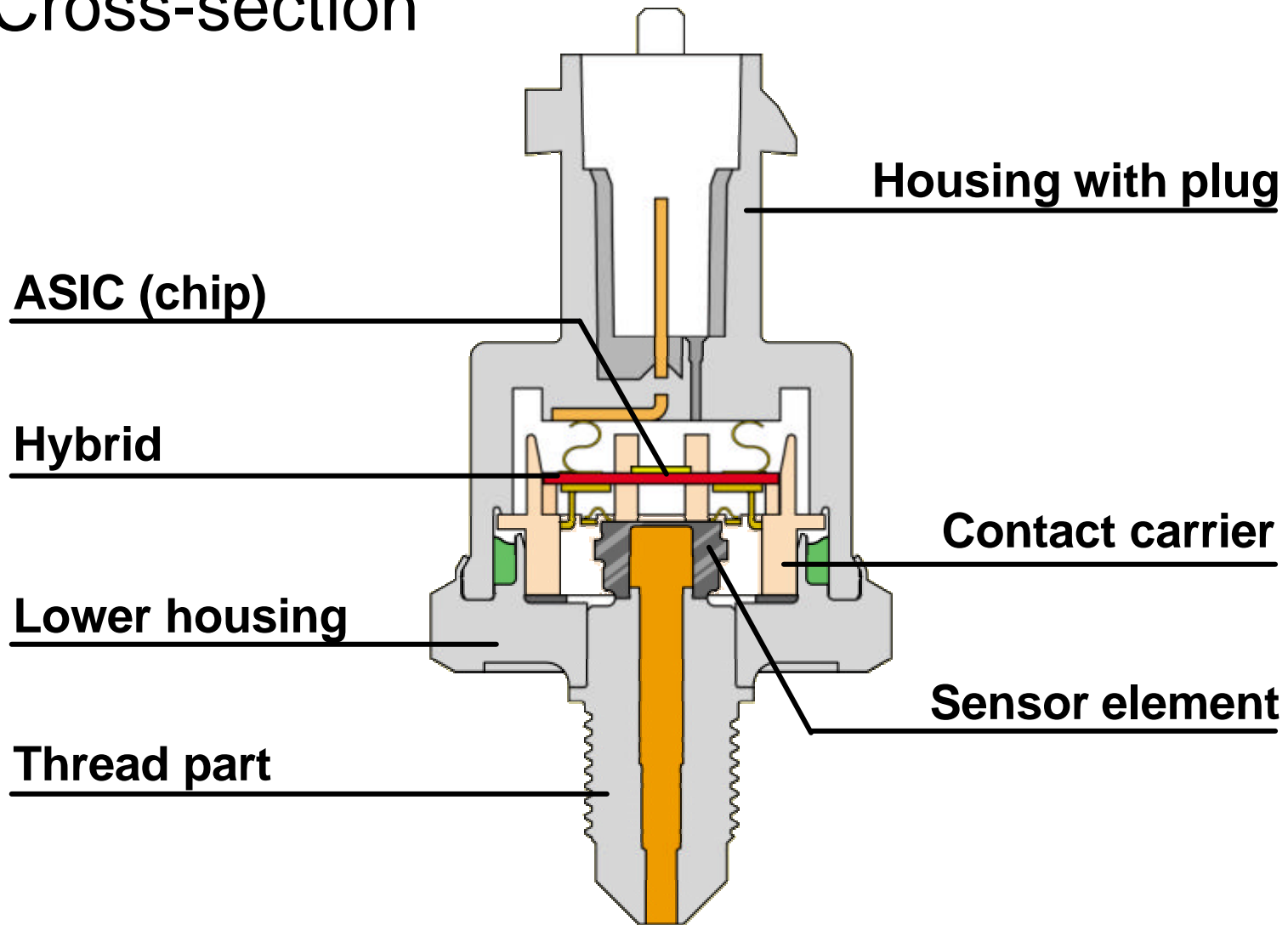


Sensor element





Cross-section





- Mounting M10x1, conical sealing seat
- electrical connection customer specific (AK, RB, ...)
- environment temperature -40°C ... +130°C; +140°C for short times
- resistance against vibration 60g (RSV, peak level)
- nominal-/ over-/ burst-pressure 14 MPa / 18 MPa / > 35,2 MPa
- supply voltage 5 Volt ± 0.25 Volt
- supply current ≤ 15 mA
- output signal ratiometric, 0.1 ... 0.9 x supply voltage
- dynamic $T_{10/90} \leq 2\text{ms}$
- accuracy 0 MPa ± 0.7% new / ± 1.2% after life time
14 MPa ± 1.5% new / ± 2.0% after life time
- protection against misconnection 8 h
- protection against over voltage 16 Volt, 8 h
- fault diagnosis signal range check
- life time 15 years, 150.000 miles
- EMC resistance stripline 200 V/m; ISO-pulses 1, 2, 3a, 3b
- ESD resistance ± 7 kV direct, ± 15 kV air discharge

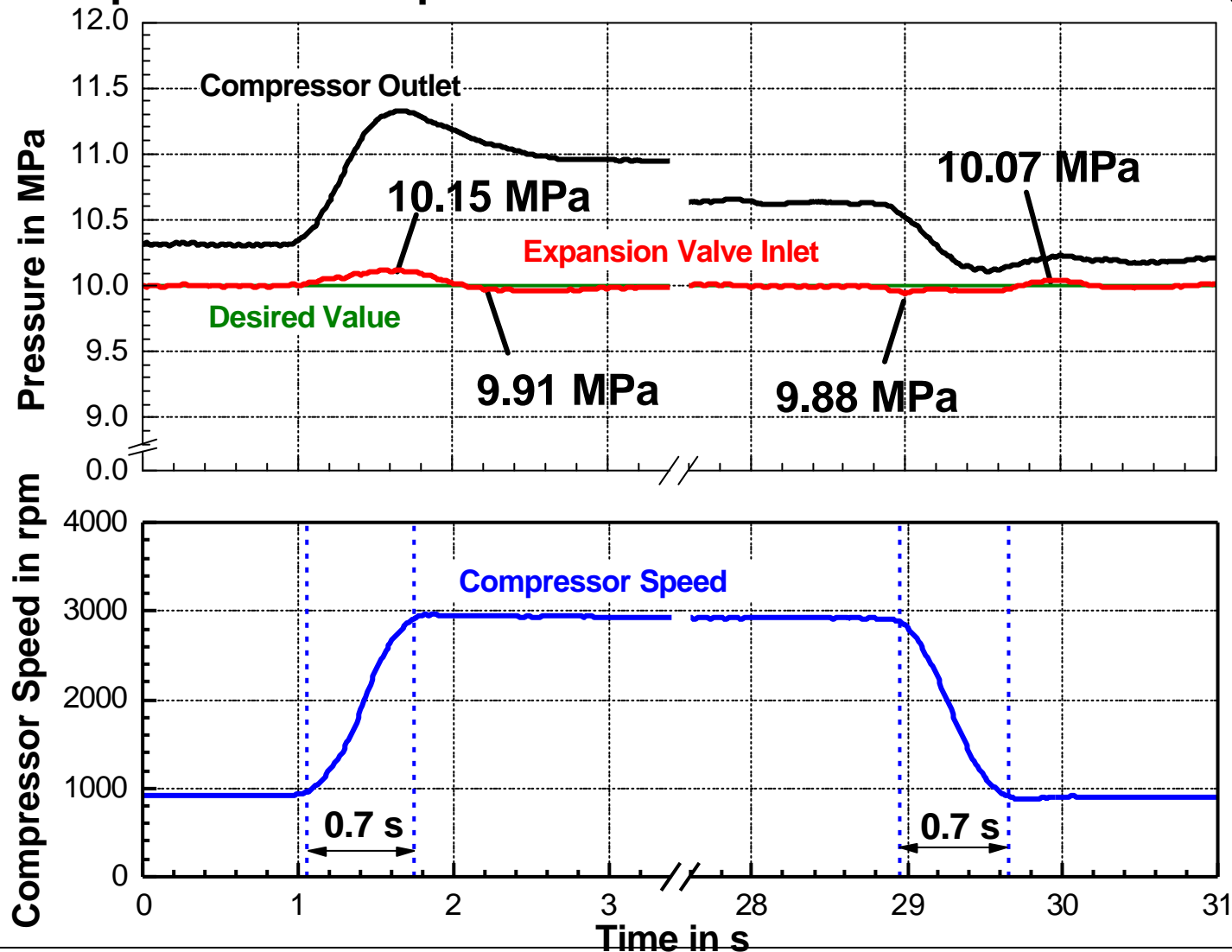


Test Rig and Vehicle



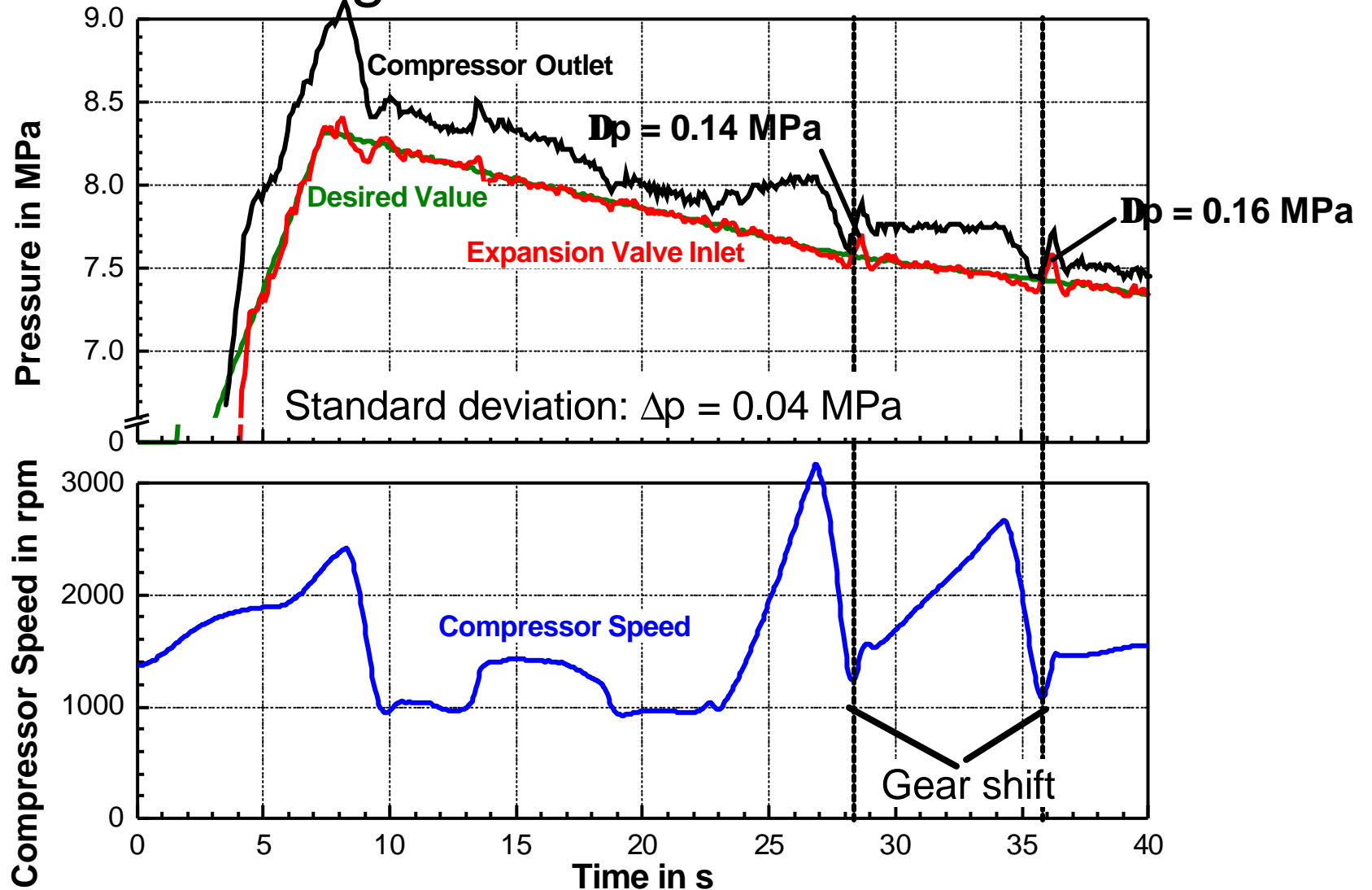


Compressor Speed Variation on Test Rig





Control of High Pressure in Test Vehicle



Summary

Prototype of CO₂ Expansion Valve

- Sliding piston with scalable max cross-section area
- Excellent control response
- Silent operation
- Modification of valve for fuel-supply-systems



Pressure Sensor in Metal Thin-Film Technology

- High dynamics and accuracy
- Series production since 2001





Vision: Compact High Pressure Control Unit





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