

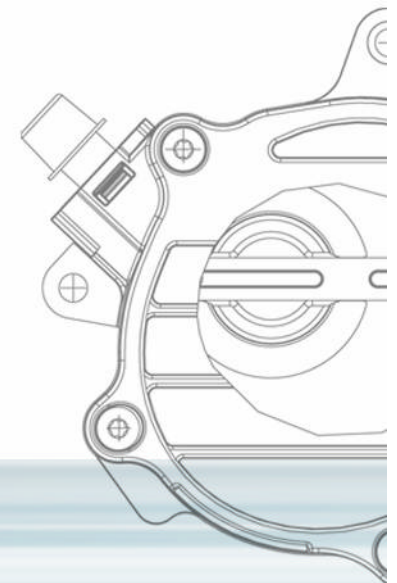
Welcome

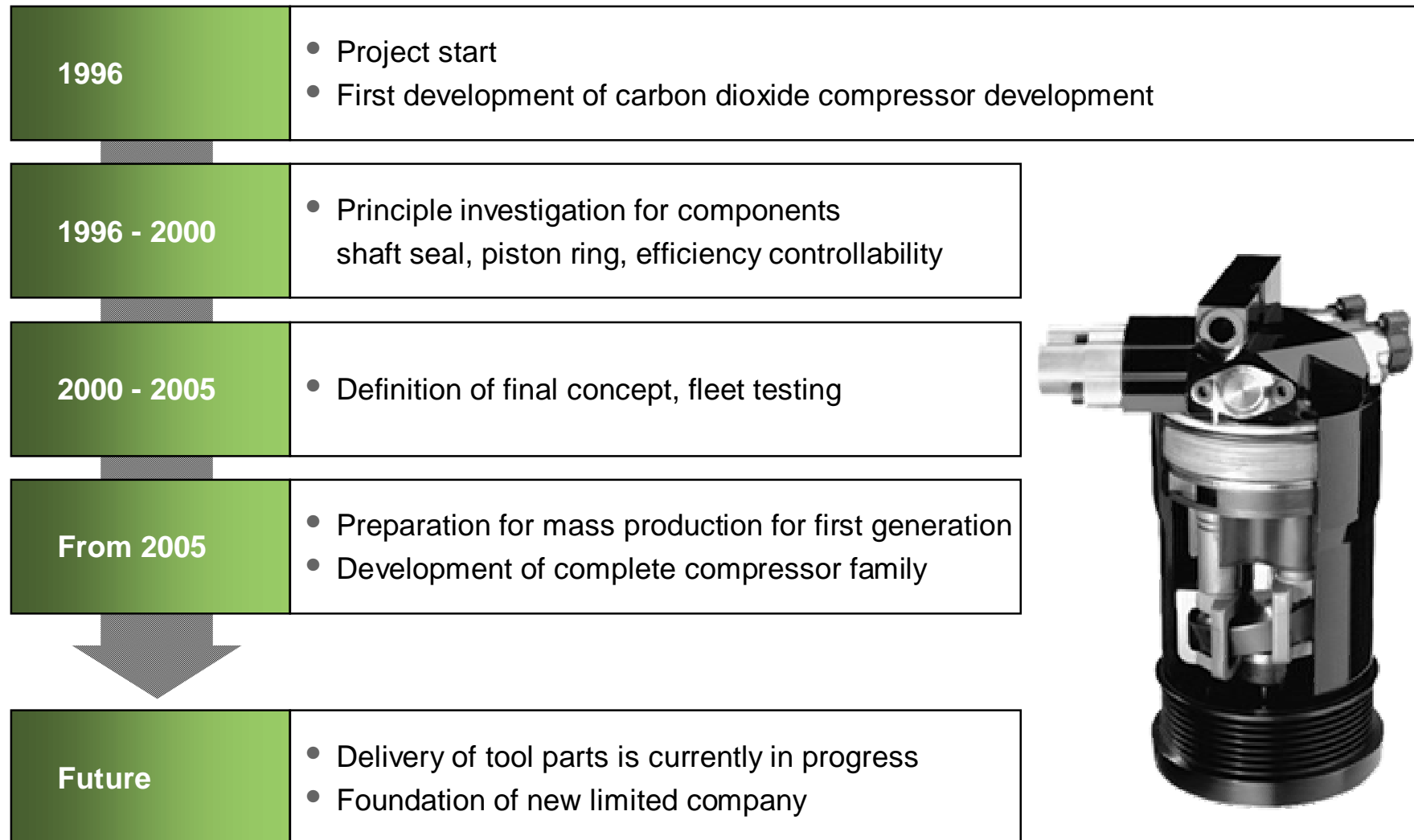
ixetic

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Precision to move

Specialists for the highest precision products in
steering, chassis, brakes and air conditioning





General requirements

- OCR – rate below 0,5% at any condition
- Leakage below 15gramm/year
- Temperature load up to 180°C oil temperature
- Reliability
- Controllability

Luxury Cars

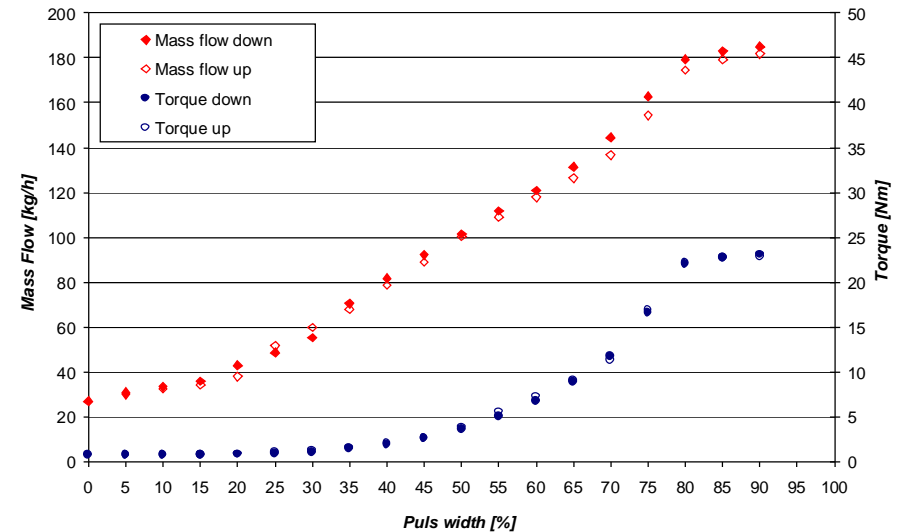
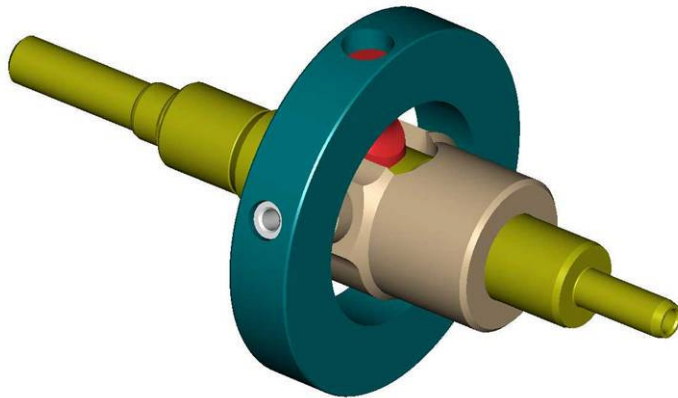
- Highest cooling performance with dual evaporator system: Mass flow 300kg/h
- NVH: Large no. of cylinders

Compact Cars

- **Compact car application needs design review to decrease costs**
- Small size and low weight, smallest number of cylinders
- Torque information within 1Nm bidirectional
- Use of fixed displacement compressors

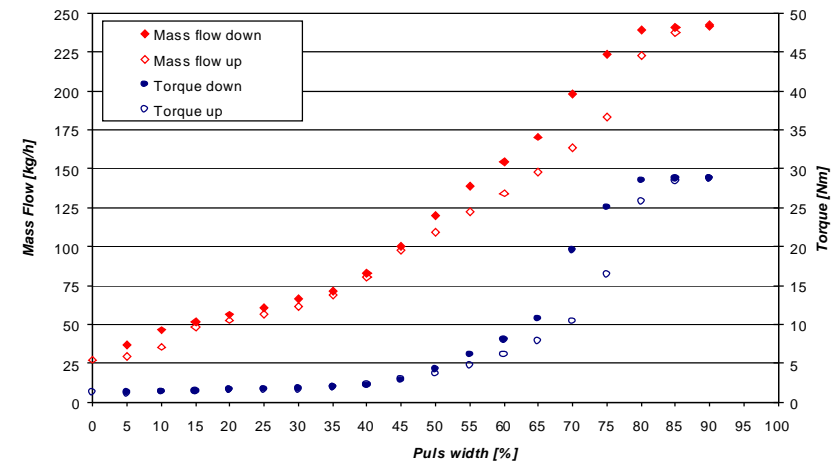
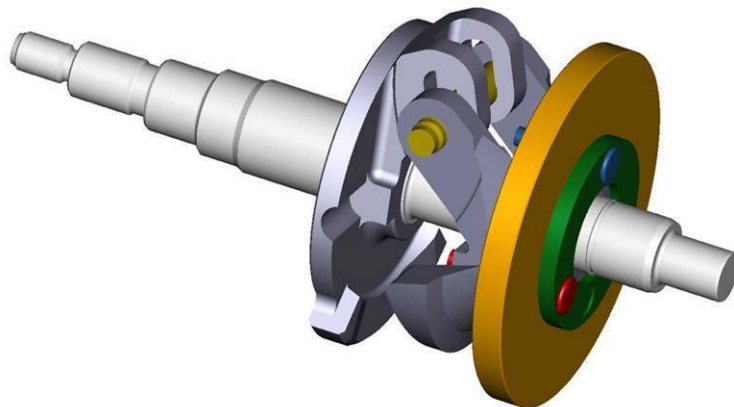
Swash-Ring drive mechanism

→ Correlation between valve signal and torque



Swash-Plate drive mechanism

→ No correlation between valve signal and torque



Torque-Monitoring for compact cars

Analytic Way to estimate driving torque ?

Option 1: Evaporator Airside Balance

Option 2: Set point of "VR"-Control Valve

Option 3: Compressor + EXV Characteristic

→ All provide limited accuracy

$\Delta h_{is} = \text{Enthalpy}(P_d; T_{d,is}) - \text{Enthalpy}(P_s; T_s)$

| P_d by P_d -sensor (if available)

| P_s, T_s Unknown; rough estimation out of Evaporator Balance

| $T_{d,is} = f(P_d; P_s; T_s; \text{Refrigerant Properties})$

→ Critical Information, low accuracy

$$Torque = \frac{\dot{m} * \Delta h_{is}}{2 * \Pi * n * h_{is}}$$

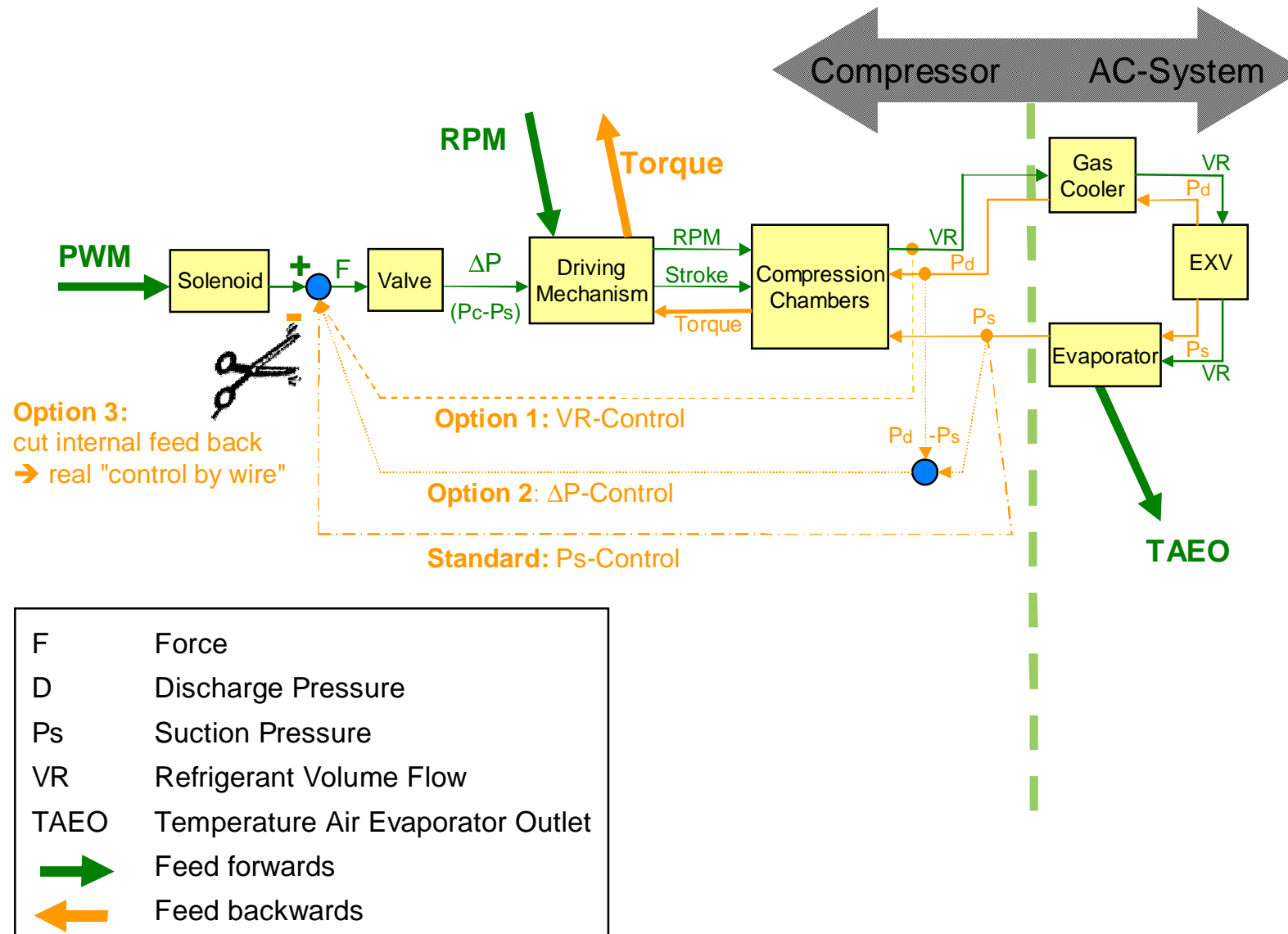
Available for Motor Management

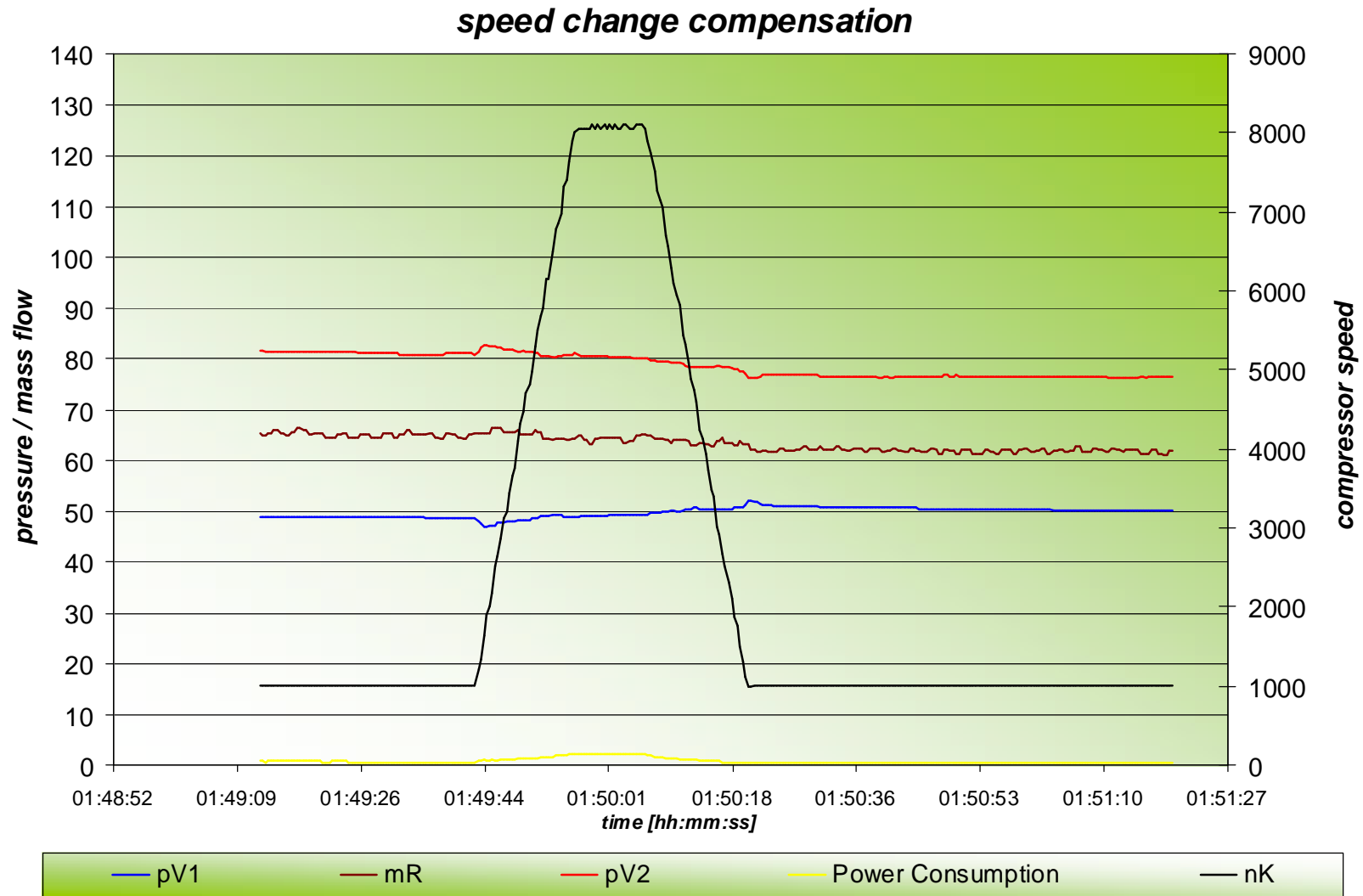
→ No Problem

Compressor test bench value provides 0,3% accuracy

→ High accuracy, but Run in Effects and Mass Production Variation to be regarded

Overkill? Have a look at the calculation Empiric Method: Torque= f (PW) - Diagram

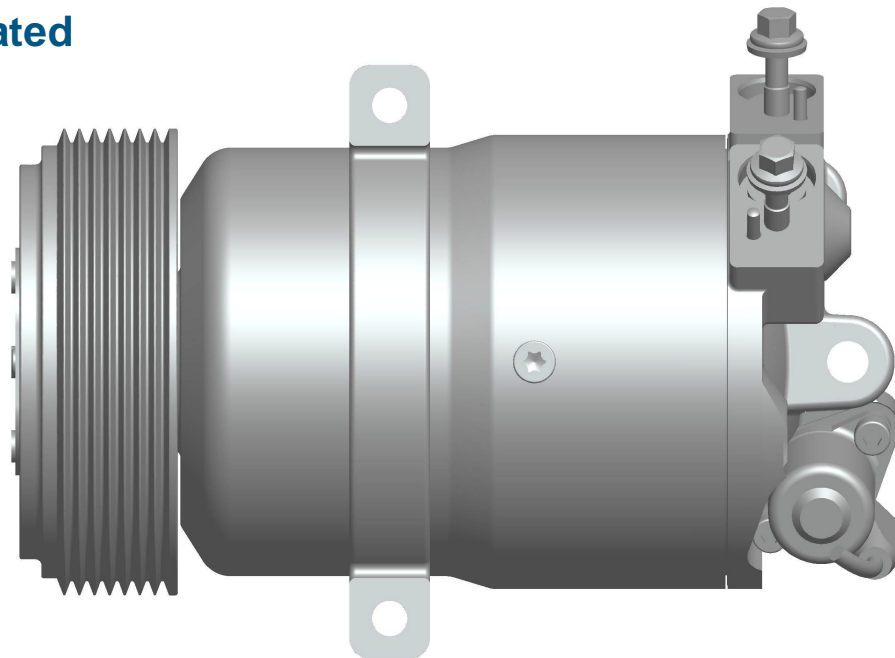


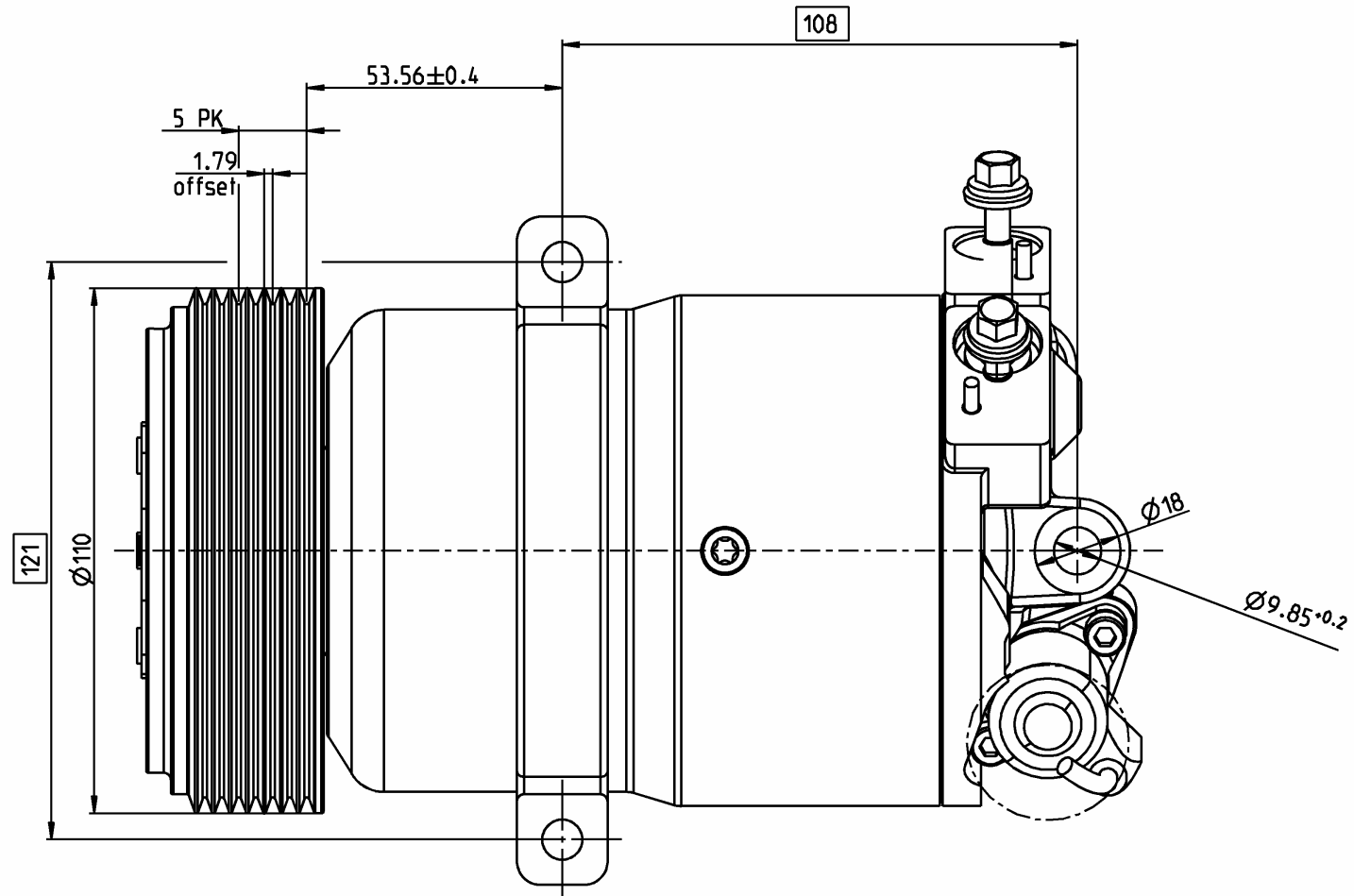


New generation swashring compressor for compact cars

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- 20-25 cc displacement,
- 100mm pulley, clutchless drive
- OCR below 0,5%,
- temperature capability 200°C permanent
- New ixetic torque management integrated
- max speed 11200 RPM
- VDA-``small``- mounting

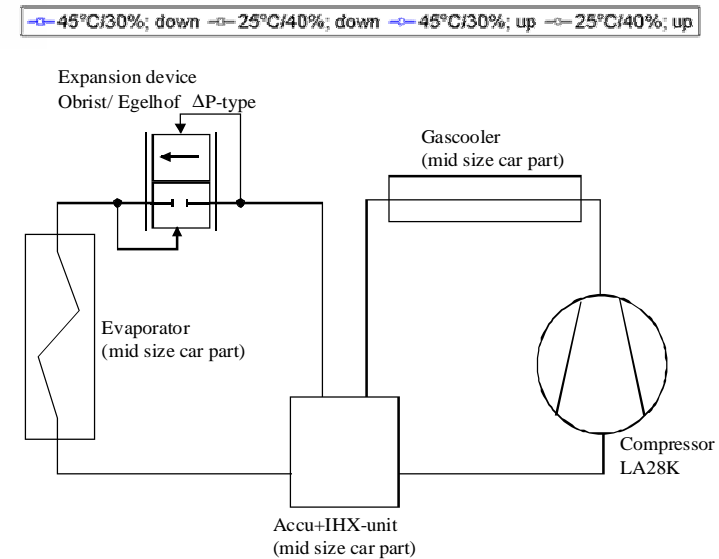
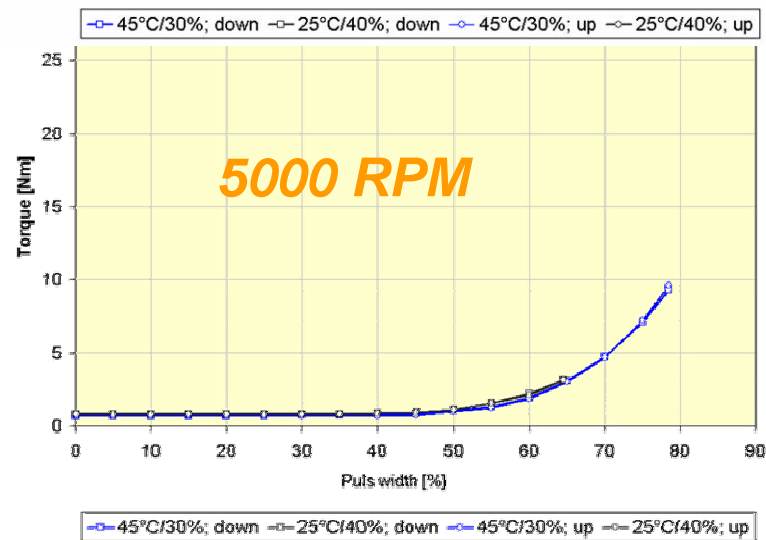
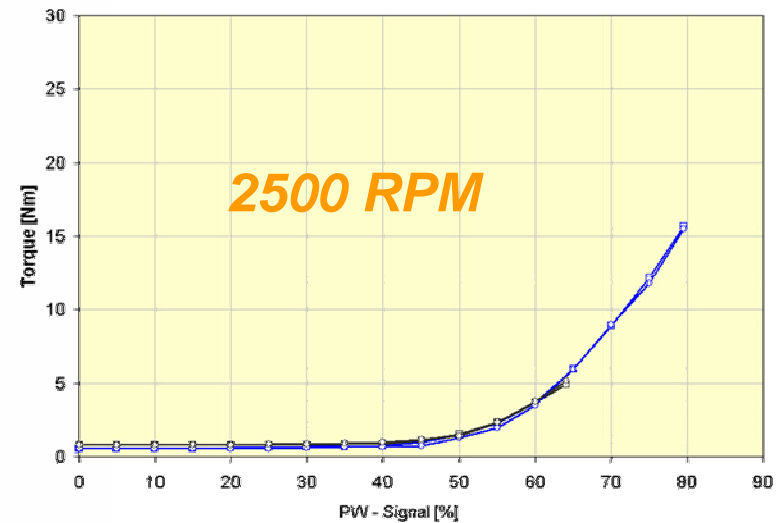
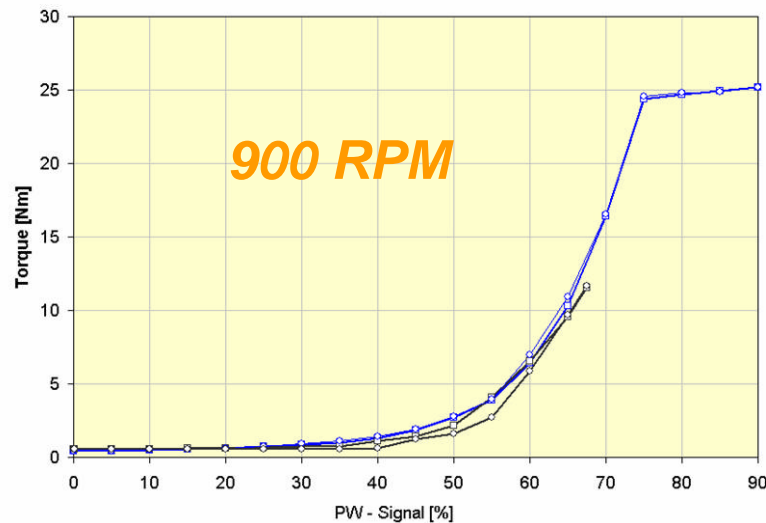


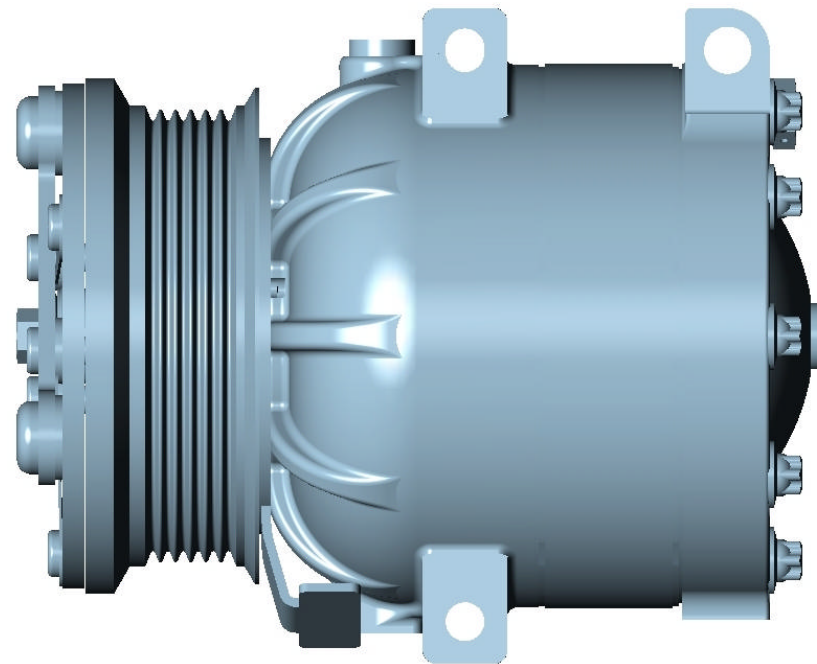


Test results

Torque management compact swash-ring in open loop mode

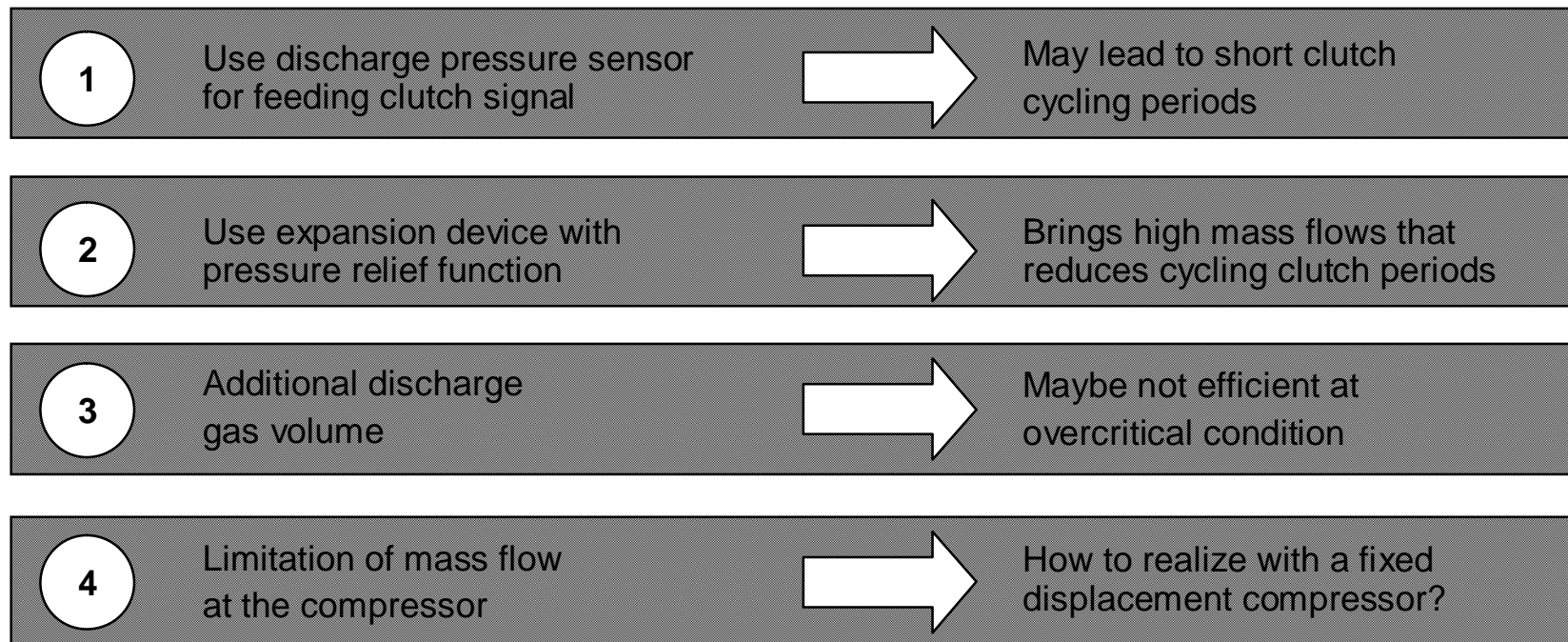
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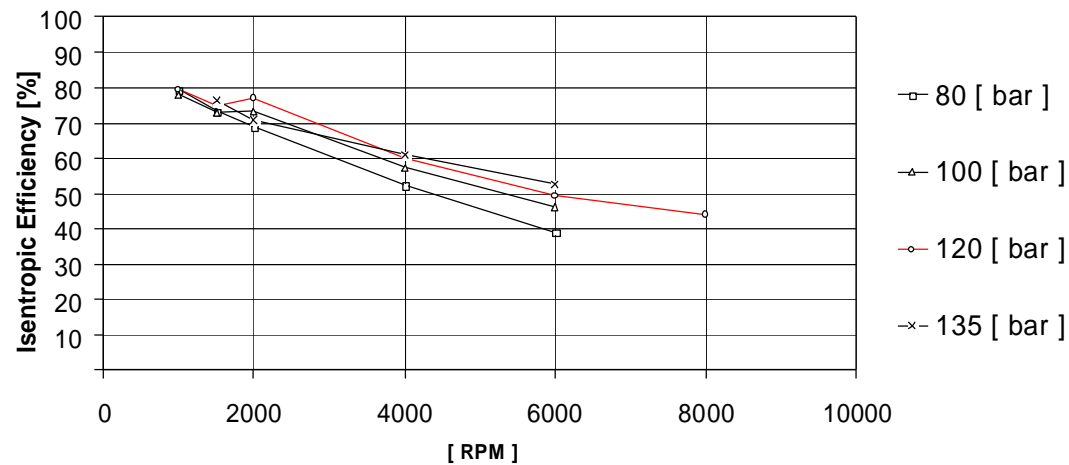
Problem: R744 operates in supercritical mode, mass flow peaks initiate very dynamic discharge pressure peaks

Question: How to avoid those pressure peaks ?



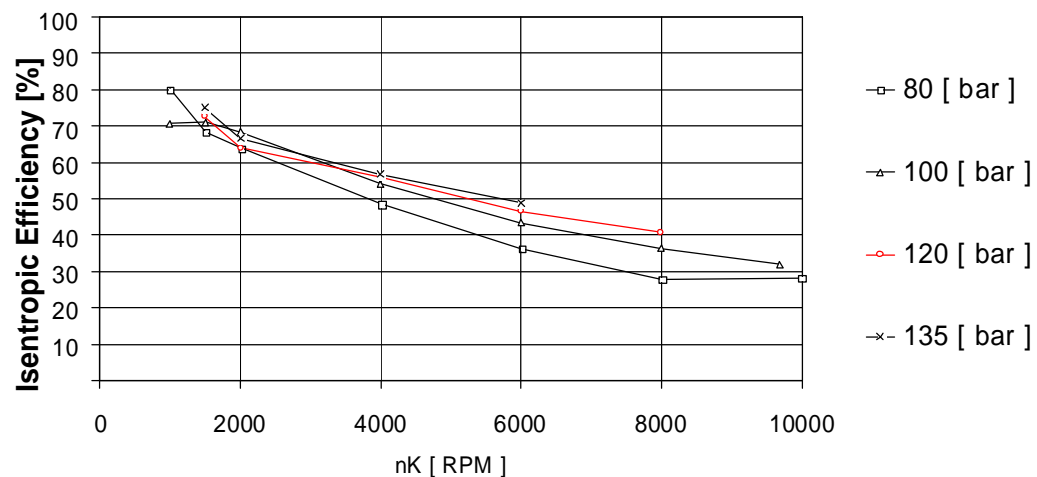
Result of mass flow limitation

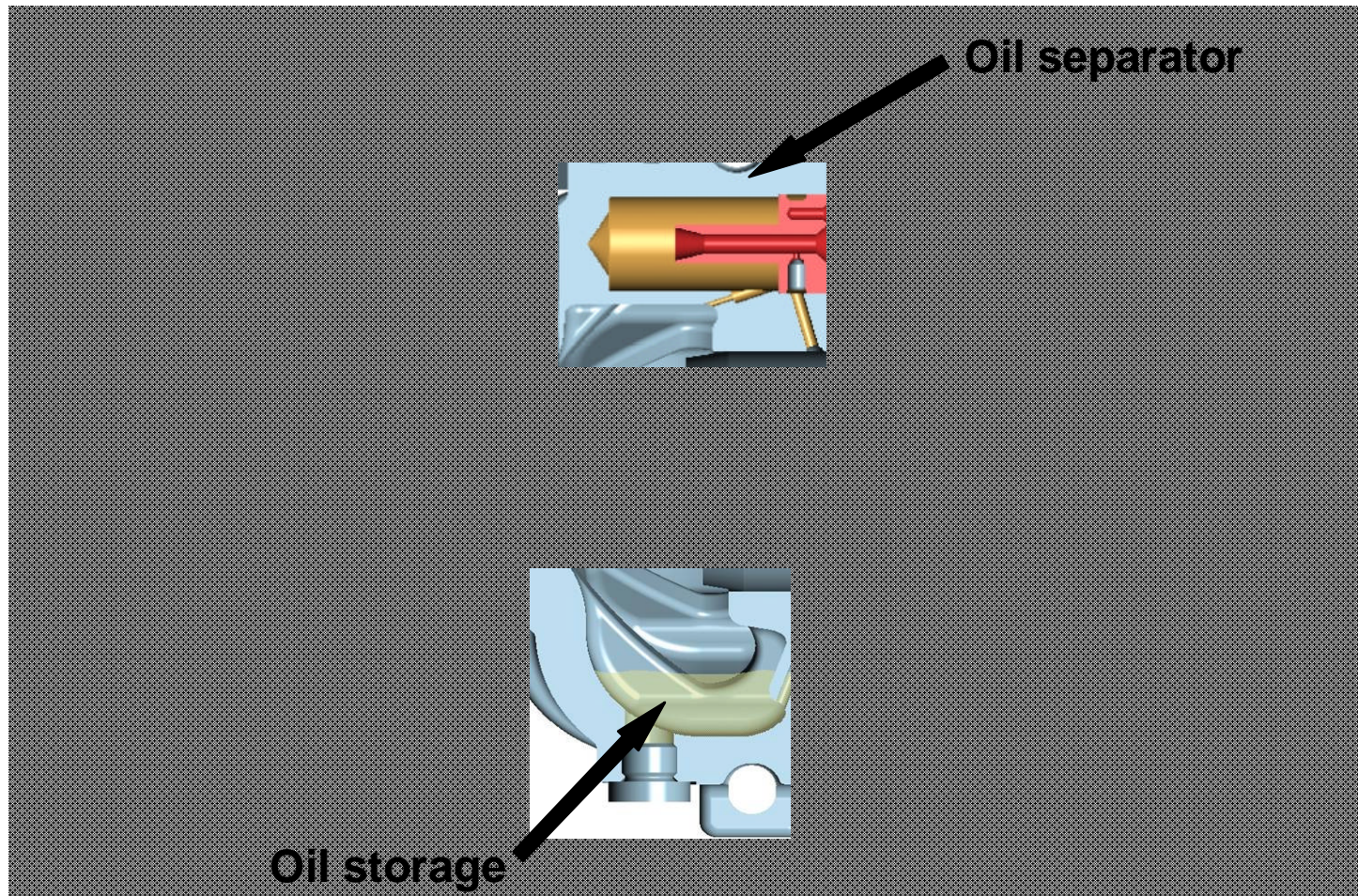
LA15K isentropic efficiency without massflow limitation
suction temperature= 30°C, suction pressure= 40 bar

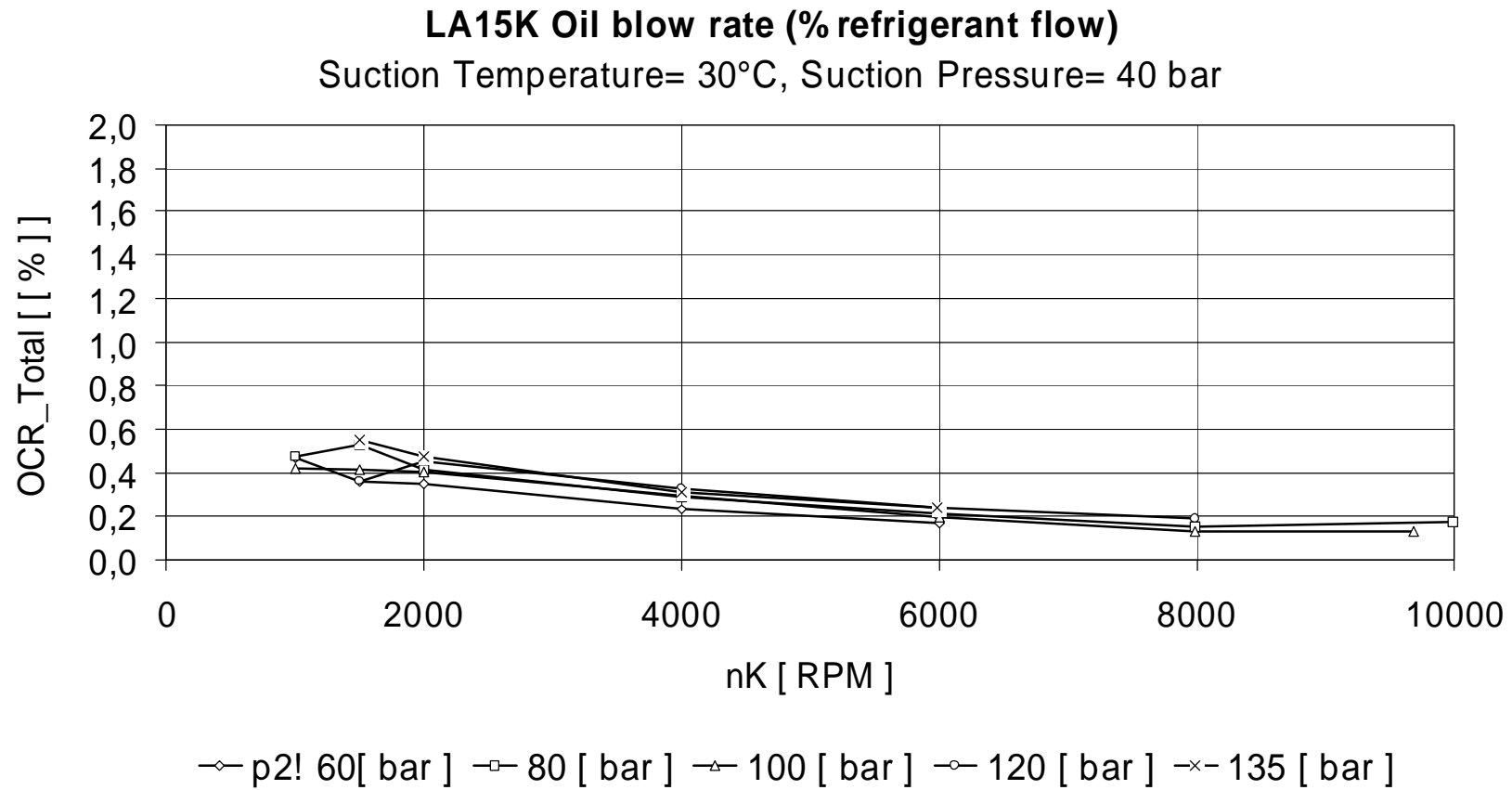


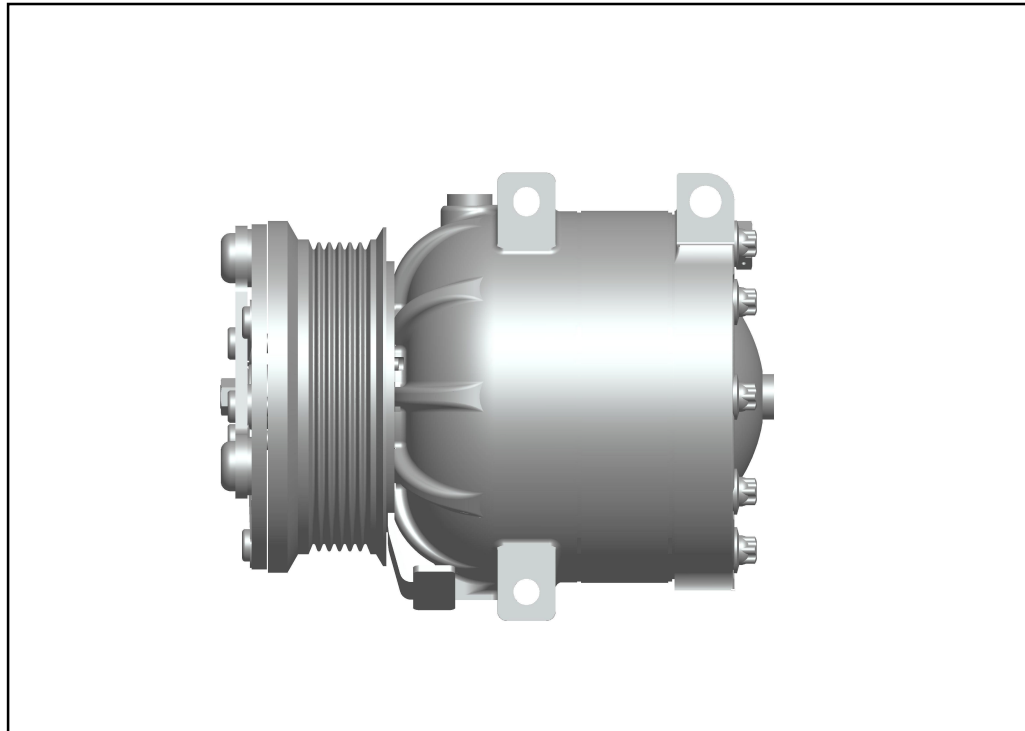
About 10% lower isentropic efficiency at low speeds.

LA15K, Isentropic Efficiency with massflow limitation
suction temperature= 30°C, suction pressure= 40 bar









Behr demonstration car uses new ixetic compressor principle

Performance and drivability are similar to R134a systems with fixed compressors!

Experience

Due to more than 10 years of development ixetic has leading experience within CO₂ compressor development worldwide

Series Production

ixetic prepares to start series production with international car manufacturers

Product Line

Complete product line covers all possible areas of application

Compact Cars

Due to compact dimensions a solution for compact cars is as well available as one for luxury cars

Efficiency & Quality

ixetic's CO₂ compressors combines high degrees of efficiency, durable design and low weight



Thank you for your attention

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For more details, go to [R 744.com](http://R744.com)