



# CO<sub>2</sub> as refrigerant for A/C and Heat Pump operation

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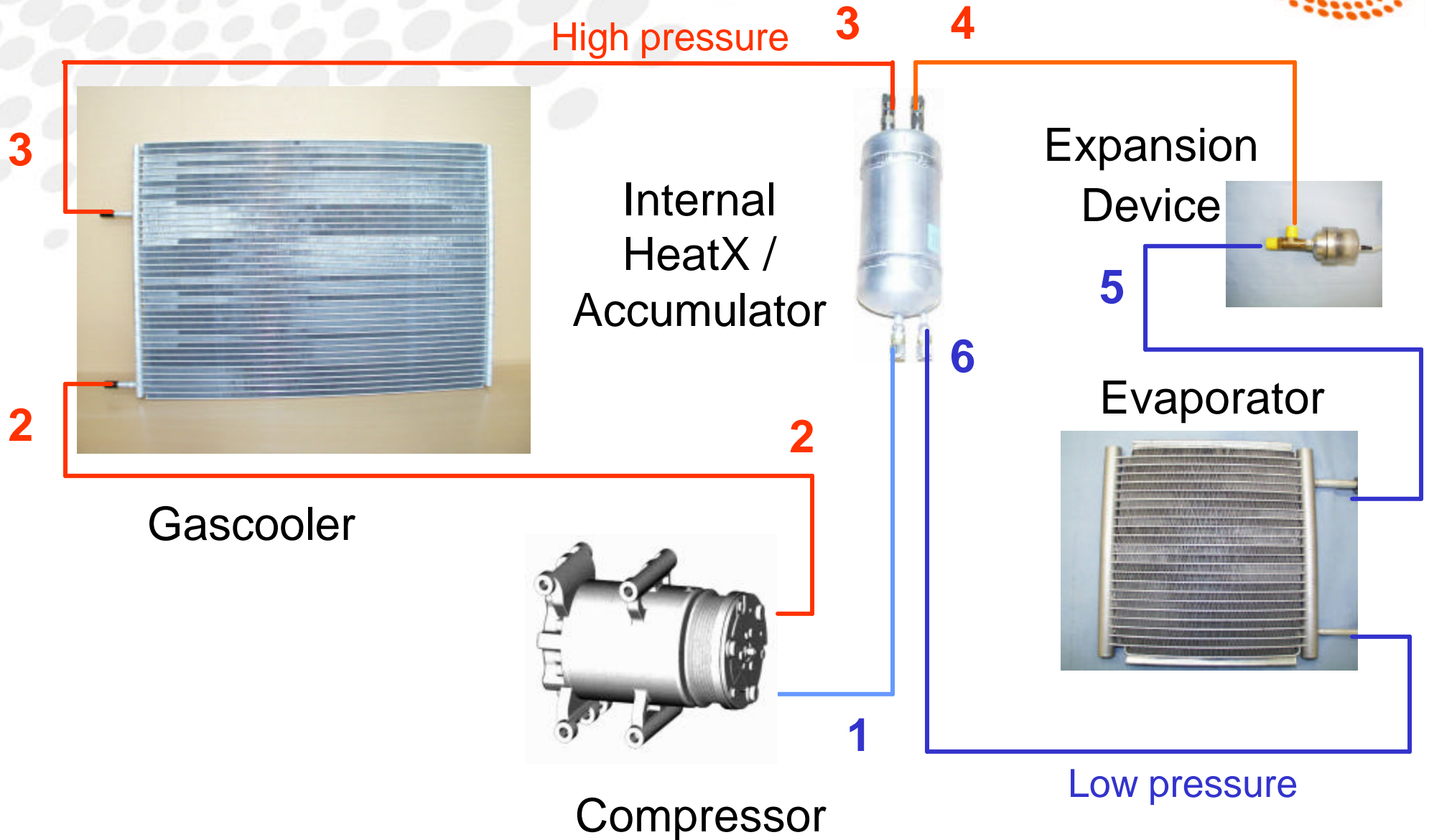


# Overview

- A/C Operation
- Windtunnel Performance
- Heat Pump Operation

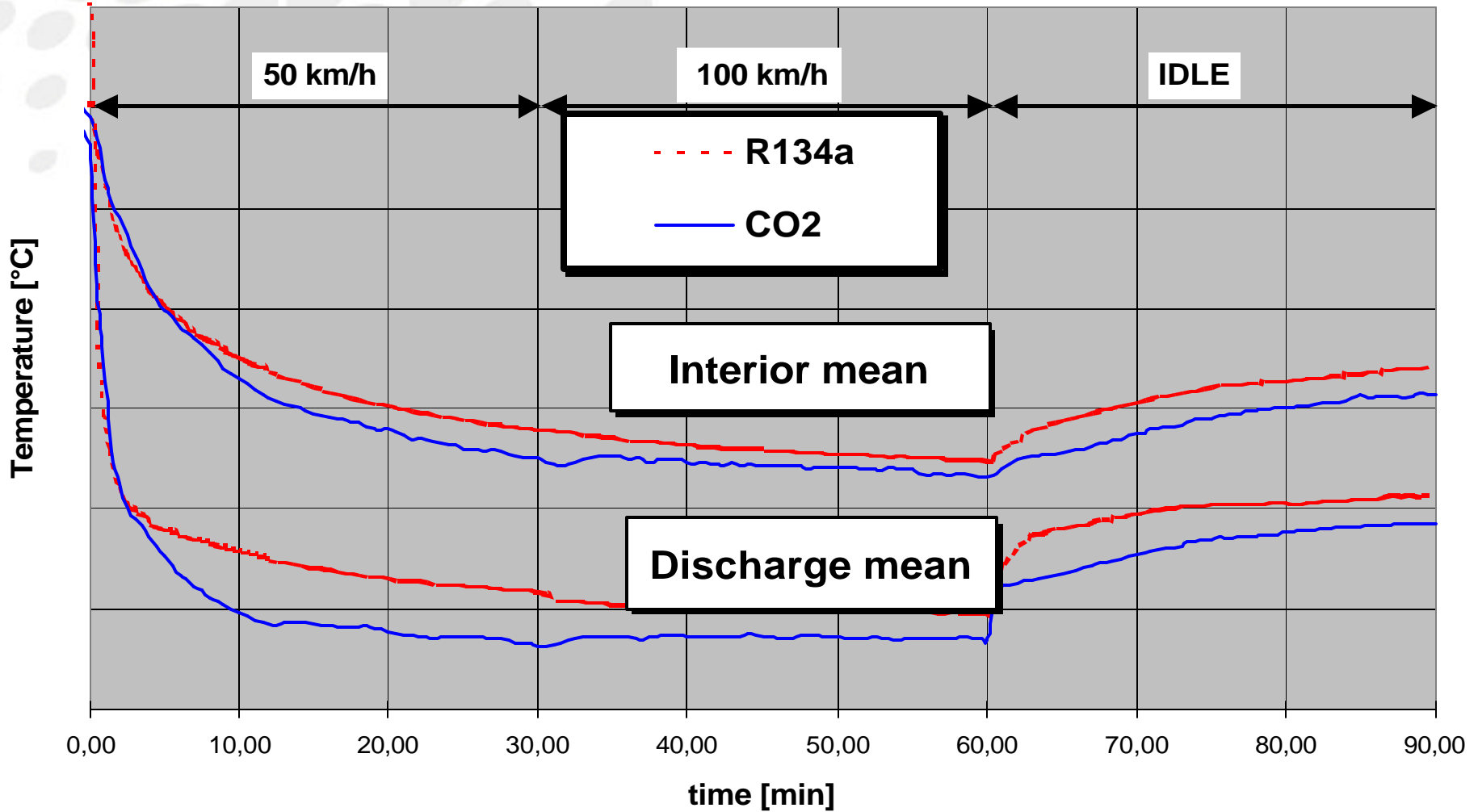


# System Layout



# Cooldown Performance

(43°C / 110 F)

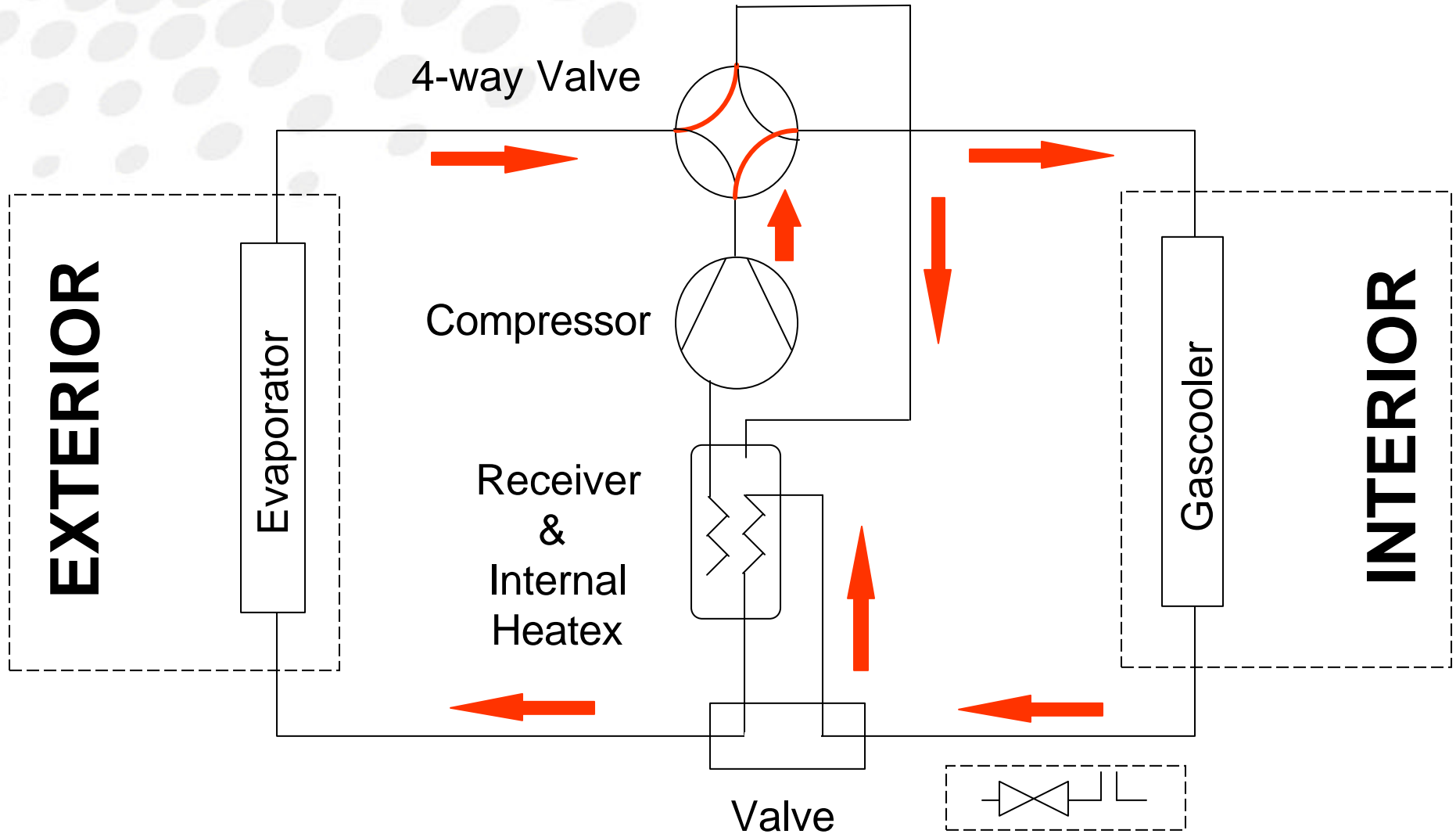


# CO<sub>2</sub> suitability for Heat Pump operation



- Low temperature capability
  - -30°C evaporating temperature
    - R134a: 0,084 Mpa / 12,2 psi
    - CO<sub>2</sub>: 1,427 Mpa / 207 psi
- Favourable pressure ratio versus R134a
  - P<sub>D</sub> / P<sub>S</sub>:
    - R134a: 10-15
    - CO<sub>2</sub>: 4-5

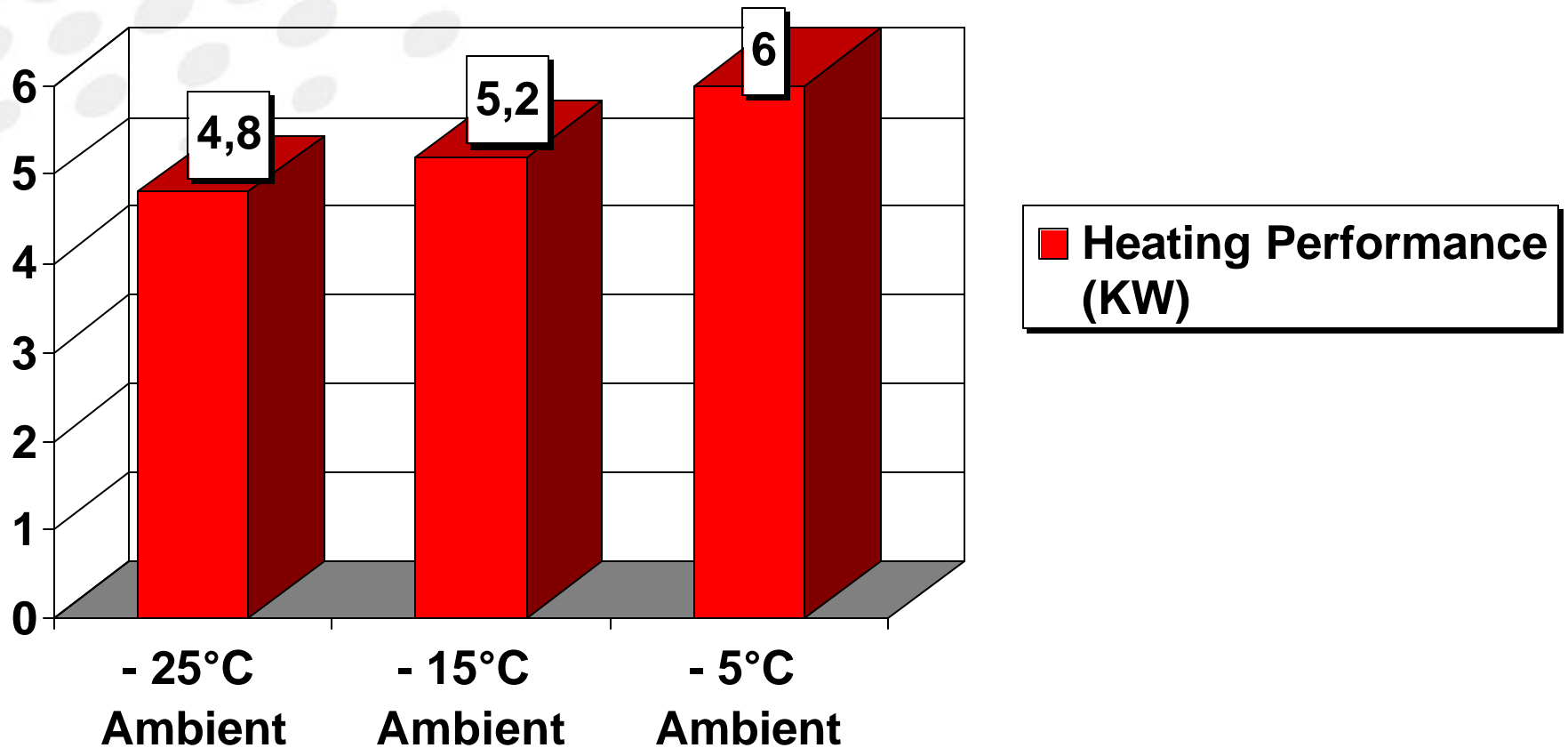
# HEAT PUMP Reverse Cycle



# Test Results



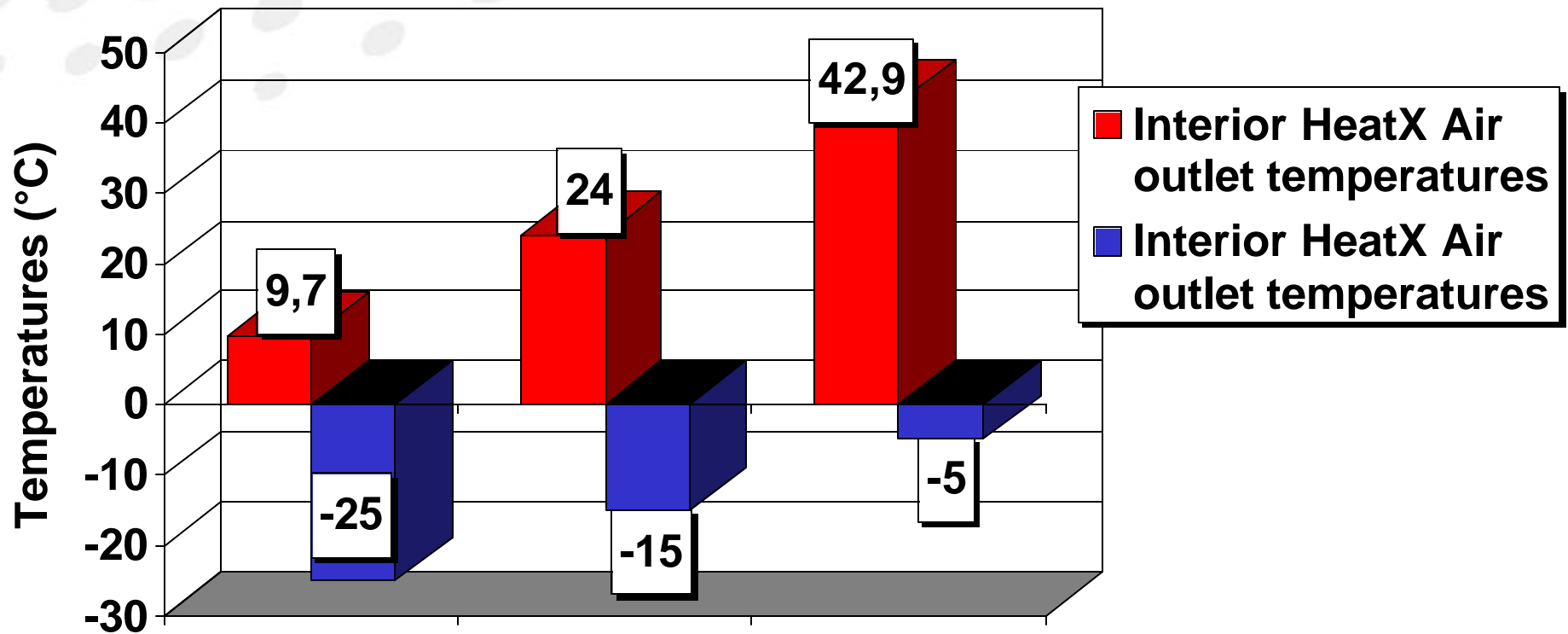
8 kg/min Interior HeatX Airflow / 2500 RPM / "Fresh Air"



# Test Results



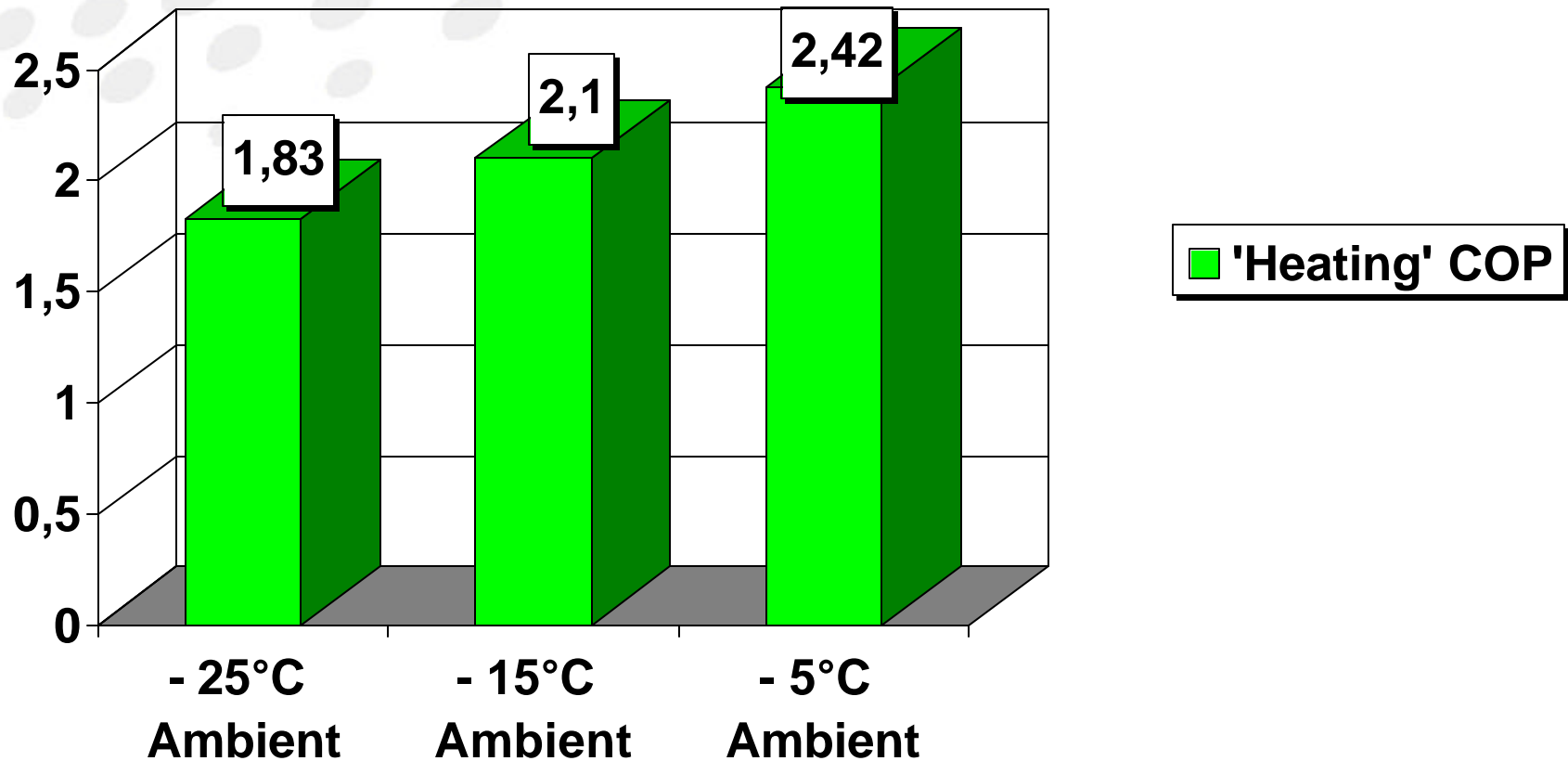
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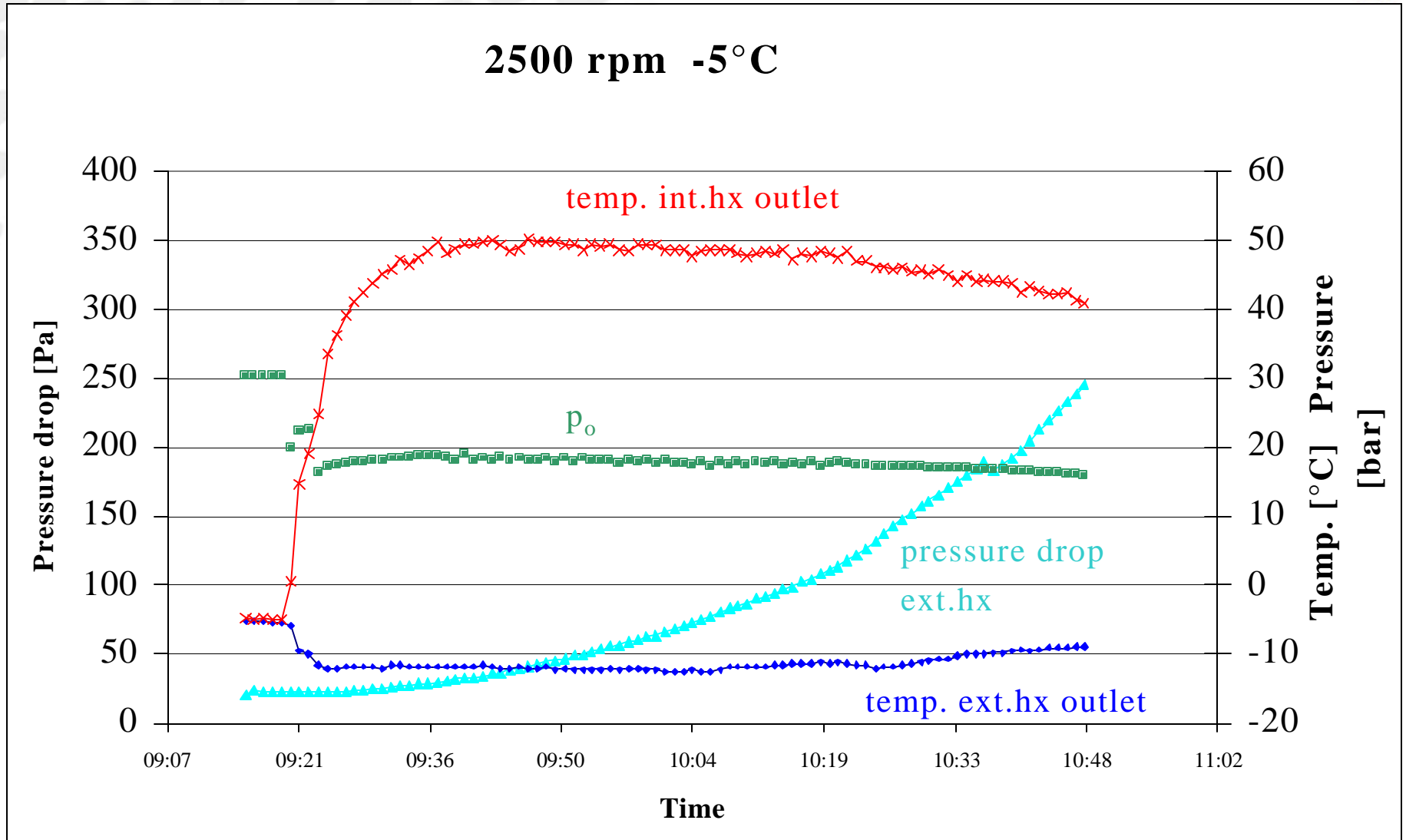
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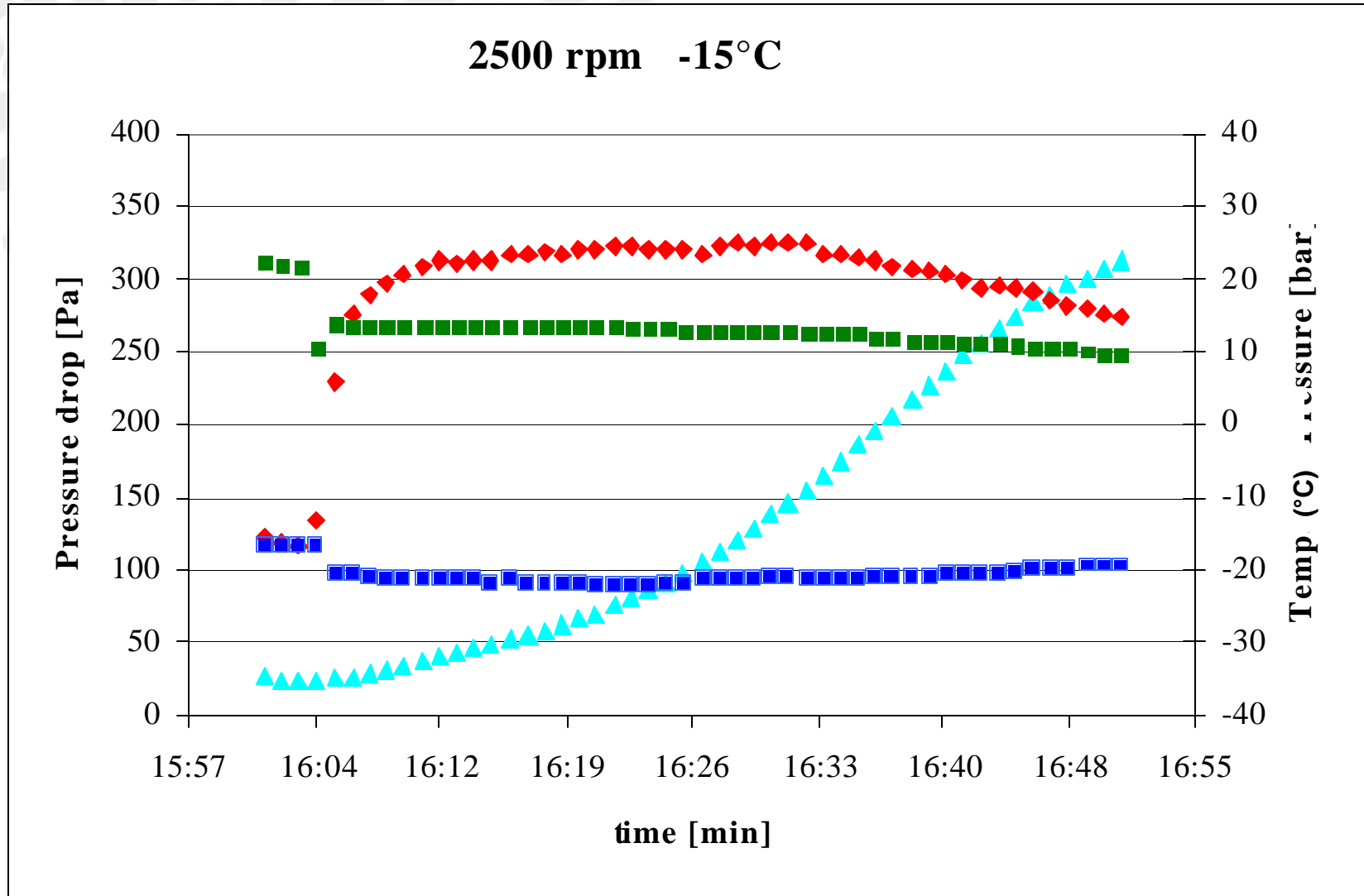
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# Reverse Cycle



# Reverse Cycle





# Challenges

- System Optimisation
- Valve Technology
- Compressor Durability

*Thank you very much for listening!*