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Interaction between ICE Exhaust Pulses and Turbine

Internal Combustion Engines

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Research

- Investigate the influence of variable valve actuation (VVA) on turbocharger performance
- Heavy-Duty applications and focused on the exhaust valves
- Identify exhaust valve strategies to
  - Improve transient response
  - Extend area of positive gas exchange work
- Explore VVA in combination with different charging concepts to improve open-cycle engine efficiency

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Tools

- **Cicero Lab:** Flow bench measurements
- **ICE Lab:** Single-cylinder HD engine with a fully variable hydraulic valvetrain
- **ICE Lab:** 6-cylinder Scania HD engine
- 1D-simulation software (GT-Power)

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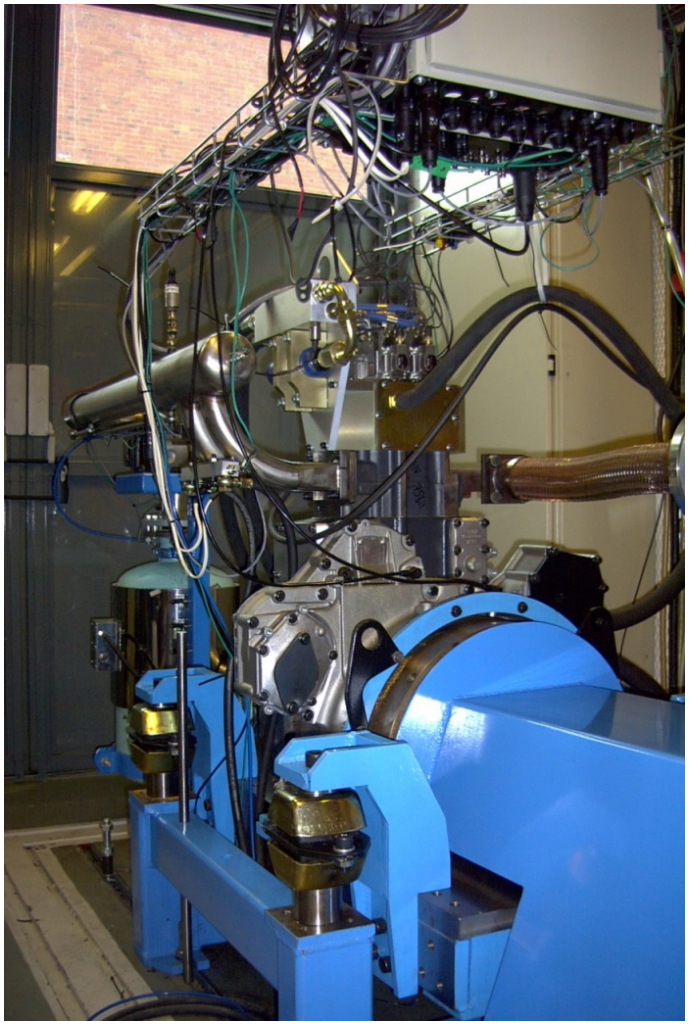
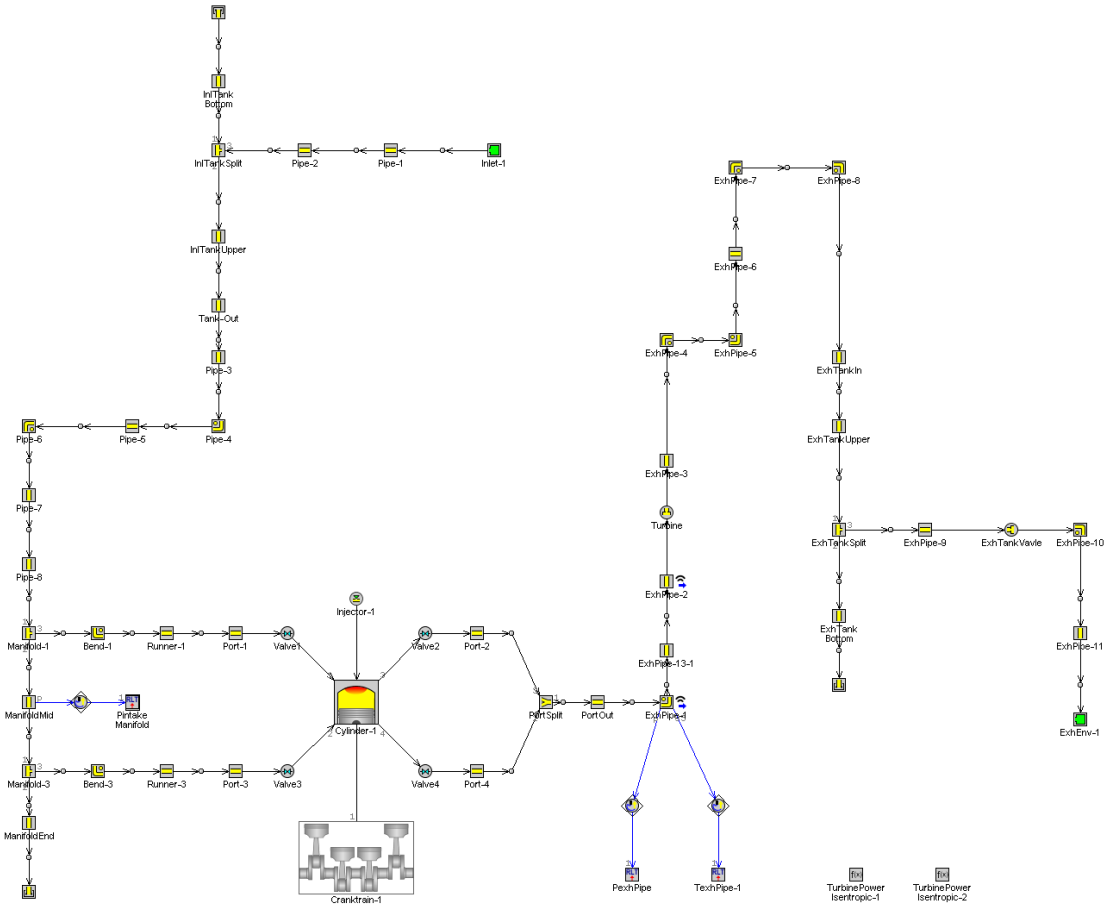
Ongoing work

Single-Cylinder Test Cell



Single-Cylinder GT-power model



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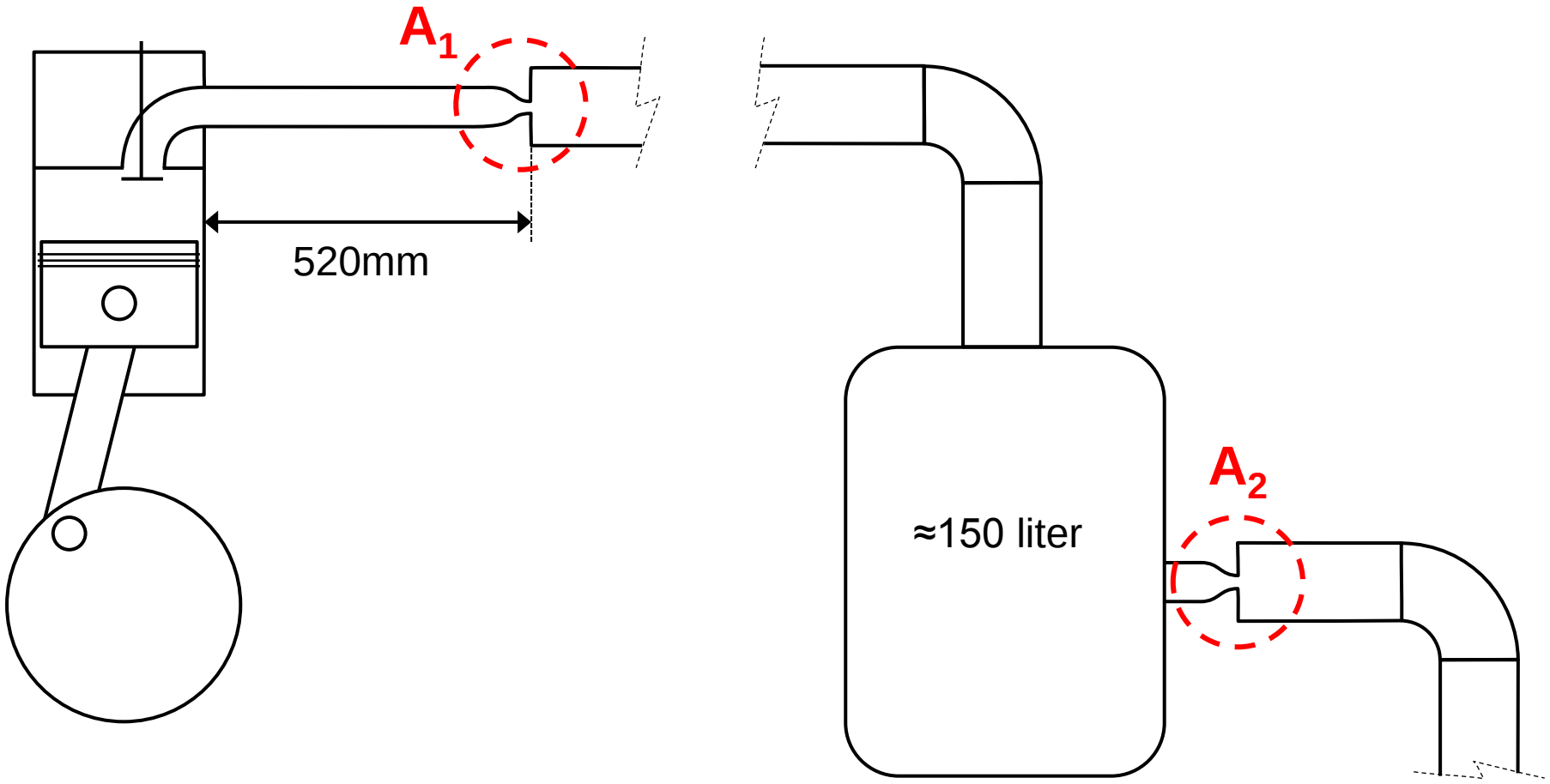
Ongoing work

- Emulate the conditions at the turbine inlet by using two orifices A_1 and A_2



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Ongoing work

- Pulse shape single-cylinder compared to a 6-cylinder engine

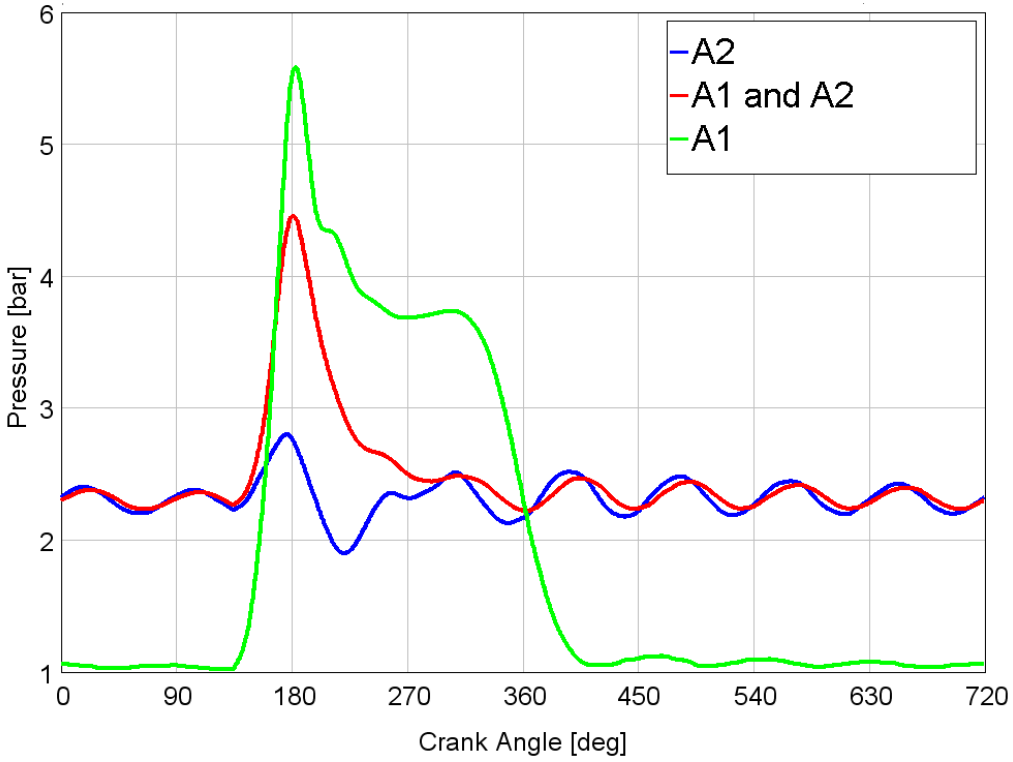

Figure 1. Pressure pulses for single-cylinder with different areas for the orifices A1 and A2.

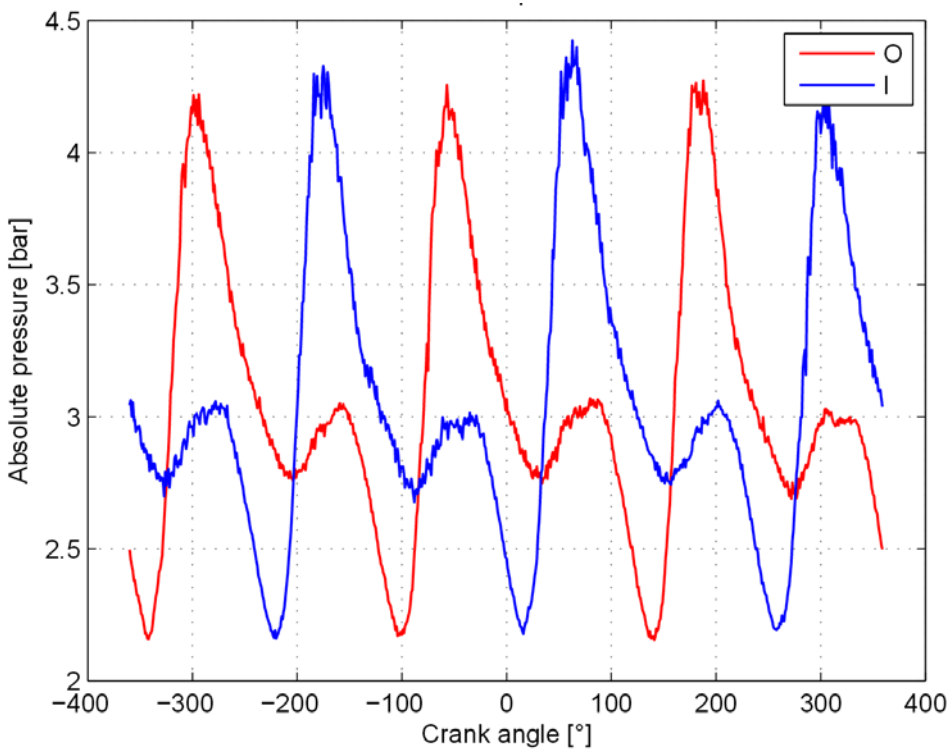

Figure 2. Pressure pulses in turbine entry Scania.*"An on-engine twin-scroll turbine performance estimation" Viktor Olsson*

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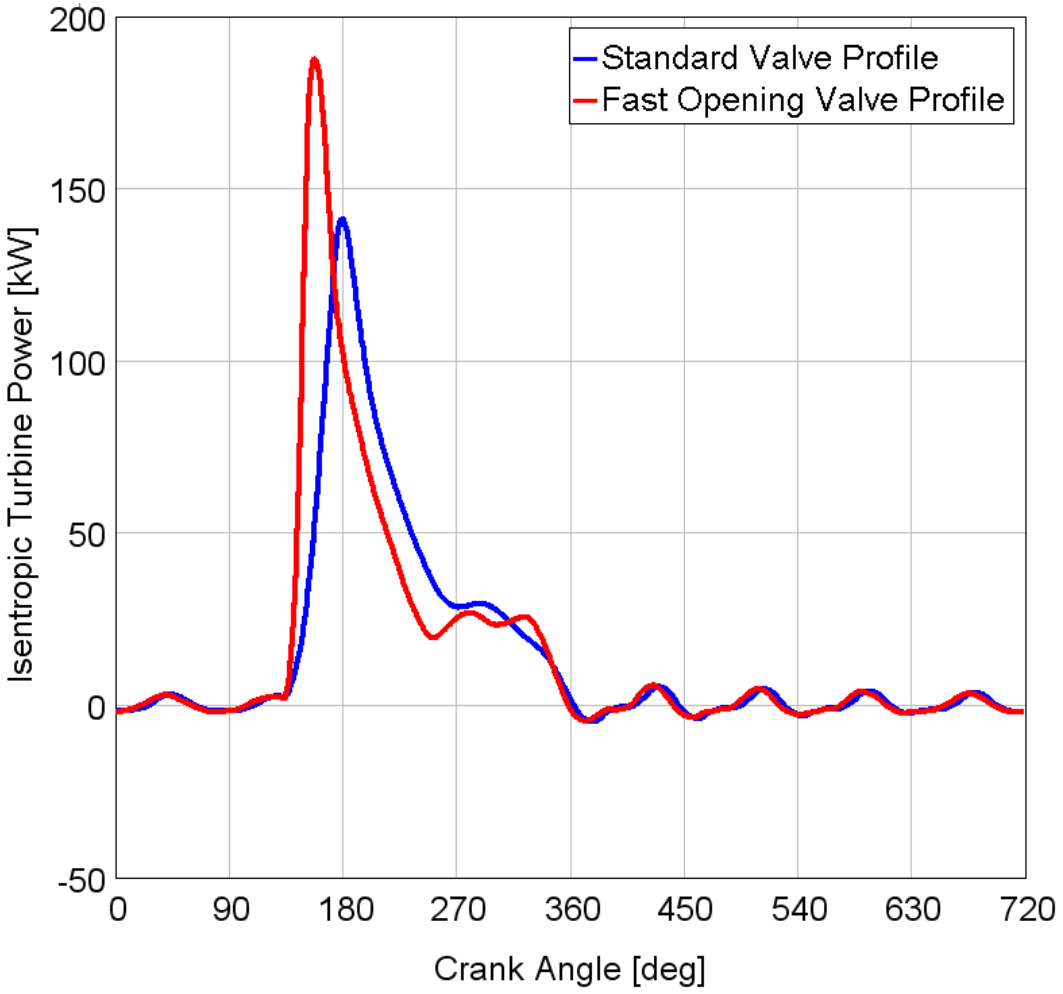
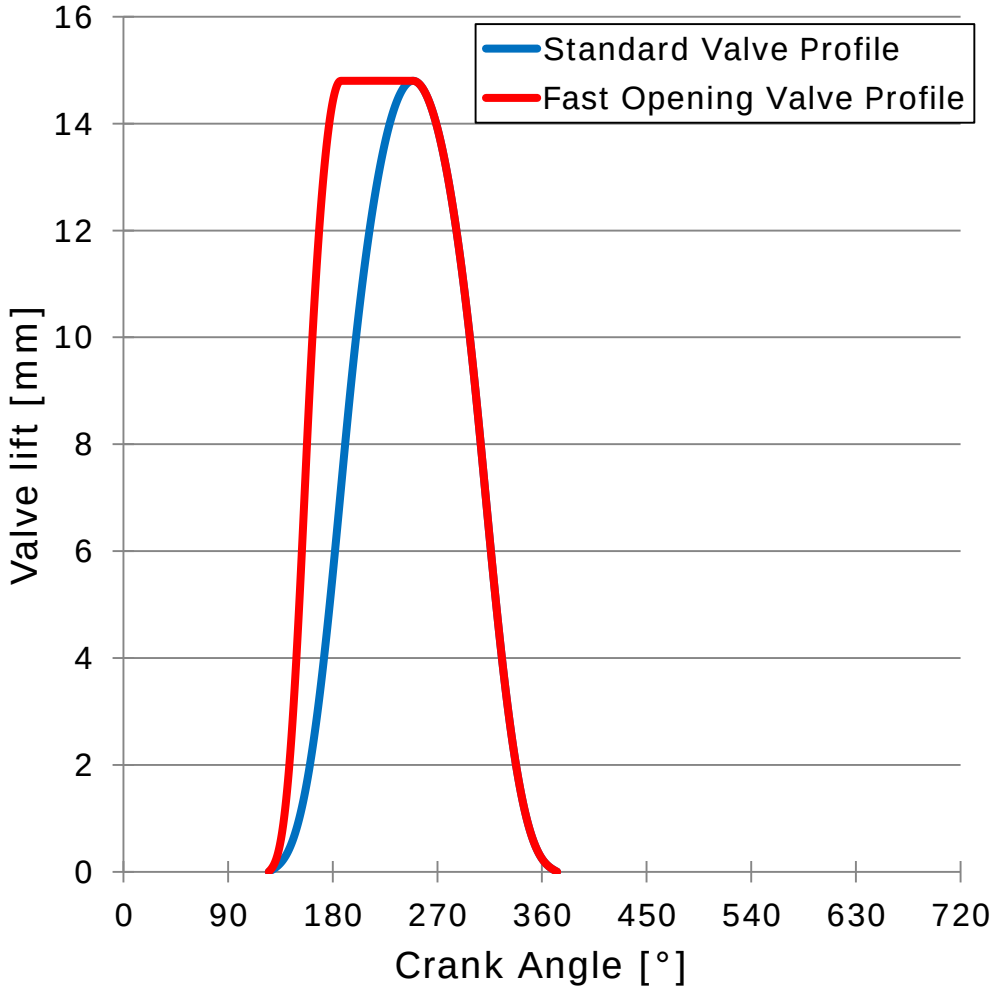
Preliminary results

- Turbine Isentropic Power

$$P_{in} = \dot{m} \cdot c_p \cdot T_{03} \left(1 - \left(\frac{p_{amb}}{p_{03}} \right)^{\frac{\gamma-1}{\gamma}} \right)$$





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Upcoming Activities (start 2016)

- **Cicero Lab:** Flow bench measurements of valve discharge coefficients
    - Steady Flow at high Pressure Ratios
    - Cylinder head
- **ICE Lab:** Single-cylinder tests to calibrate GT-power model

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Thank you for your attention

Questions?

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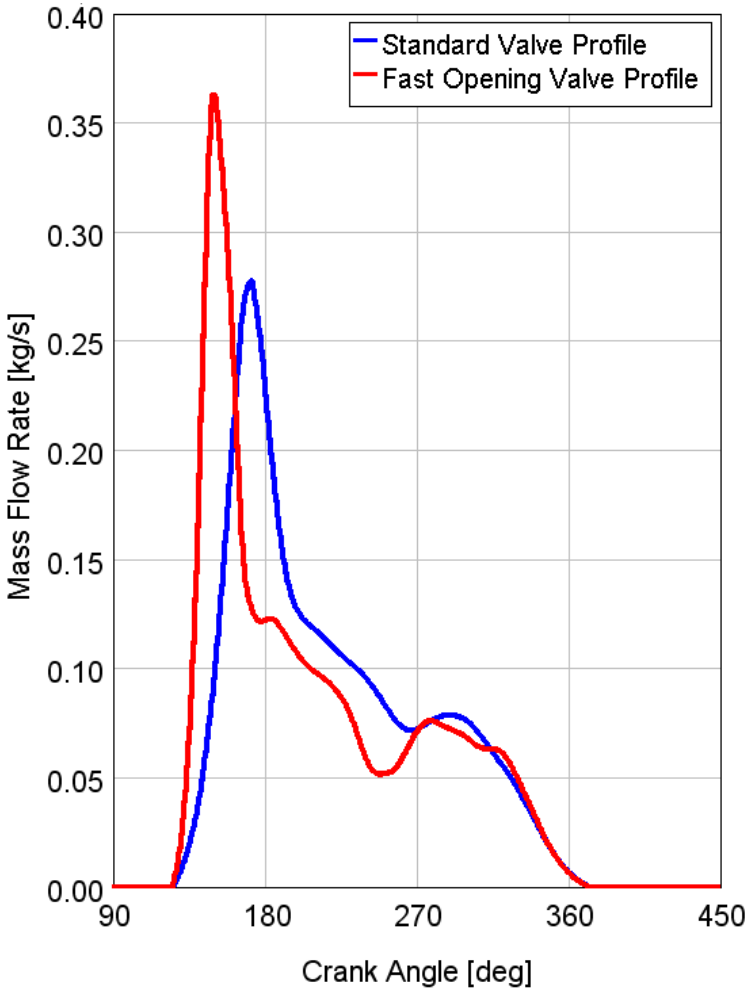
Extra slides

Valve mass flow



Valve Mach number