Competence Center for Gas Exchange

CCGEx

”Charging for the future”

Energimyndigheten SCANIA VOLVO VOLVO BorgWarner

KTH ROYAL INSTITUTE
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Pressure Ratio Influence on Exhaust Valve Flow Coeffcients

Ted Holmberg

Summary

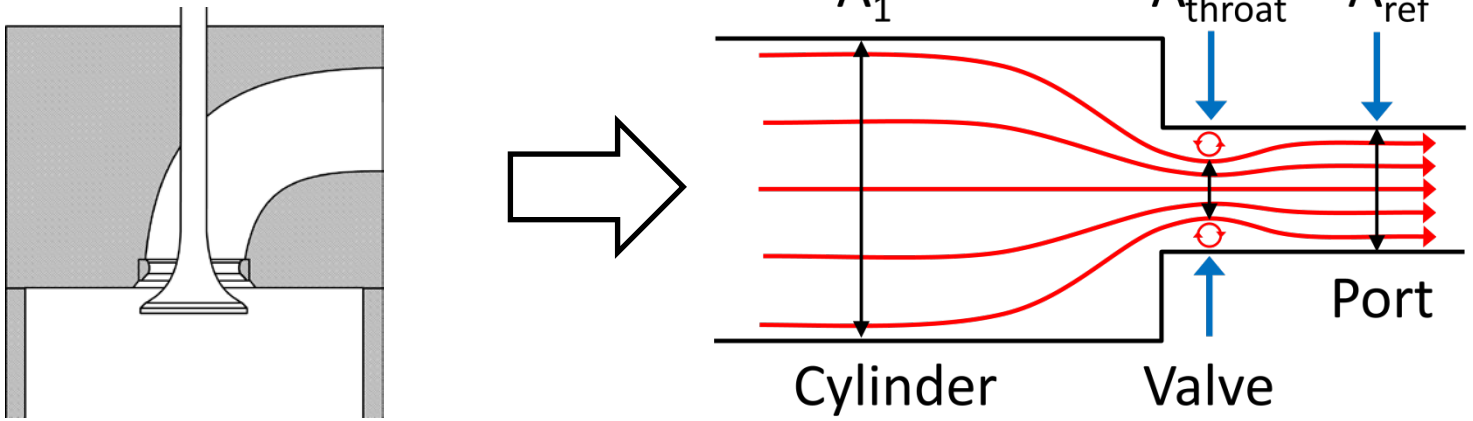
- **1-D modelling assumption of constant exhaust valve C_F found to be questionable**

- **1-D modelling assumption of similar C_F behavior of single and twin valves found to be questionable**

- **Conclusions from draft “17PFL-0905” submitted for SAE world congress**

Introduction

- 1-D description of flow losses over the valve and port



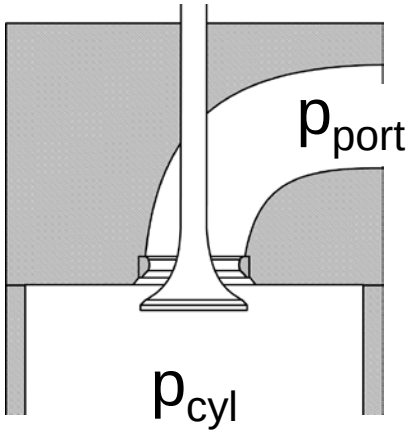
- Flow coefficient

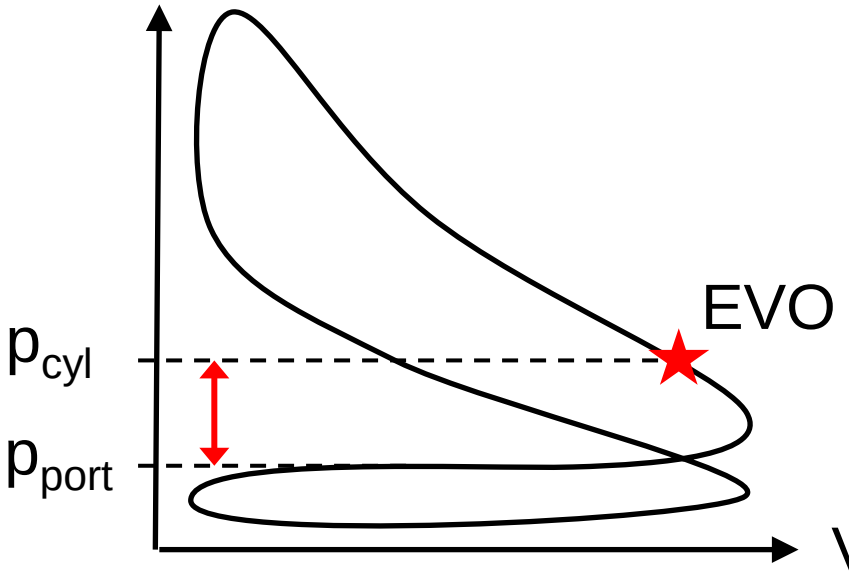
$$C_F = \frac{A_{throat}}{A_{ref}}$$

A_{ref} = Exhaust Port Outlet Area

Introduction

- Common assumption of insignificant influence of pressure ratio (p_{cyl}/p_{port}) on the flow coefficient C_F

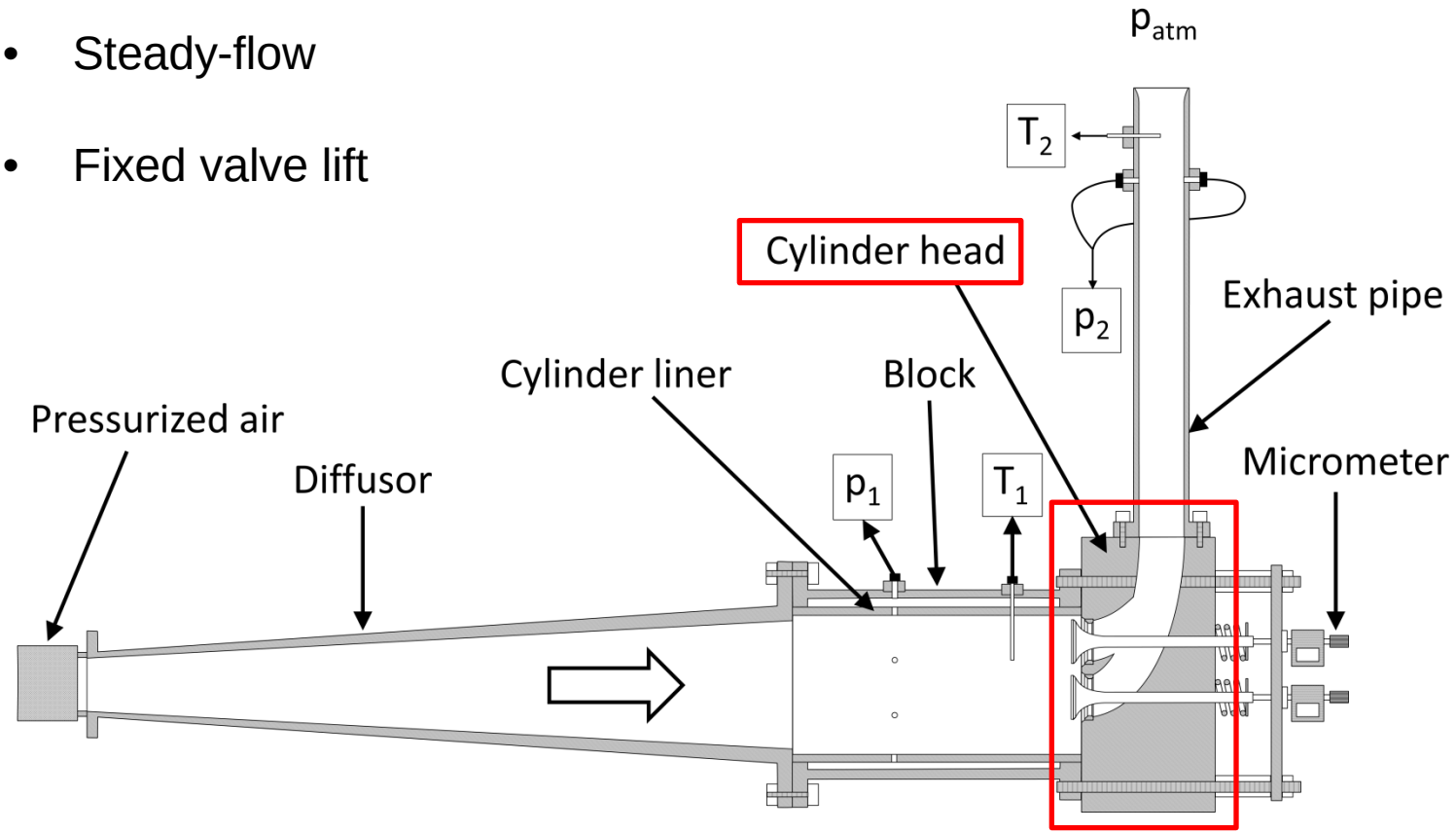




⇨ Experimental study of pressure ratio on the flow coefficient C_F

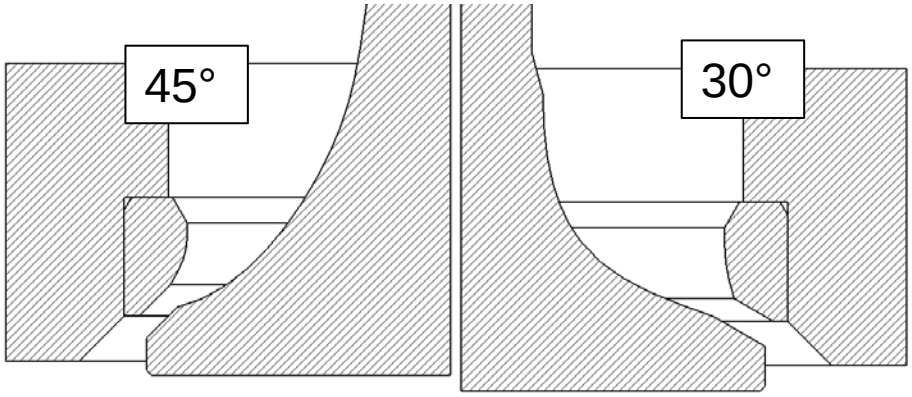
Experimental setup

- Steady-flow
- Fixed valve lift



Cases

- Valve geometry and valve seat angle (45° and 30°)



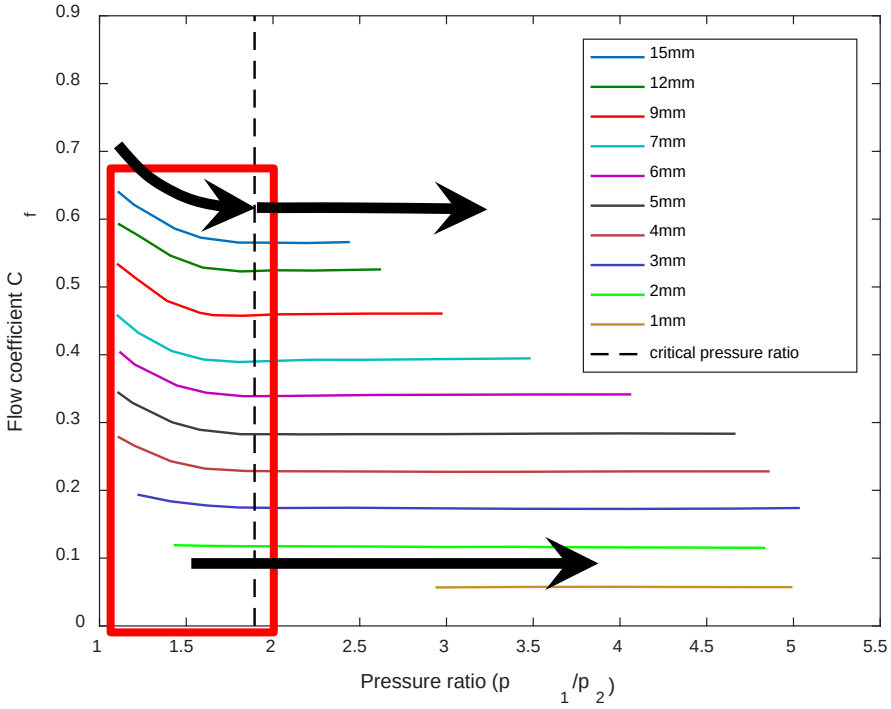
Adapted from Semlitsch et al. "Flow effects due to valve and piston motion in an internal combustion engine exhaust port"

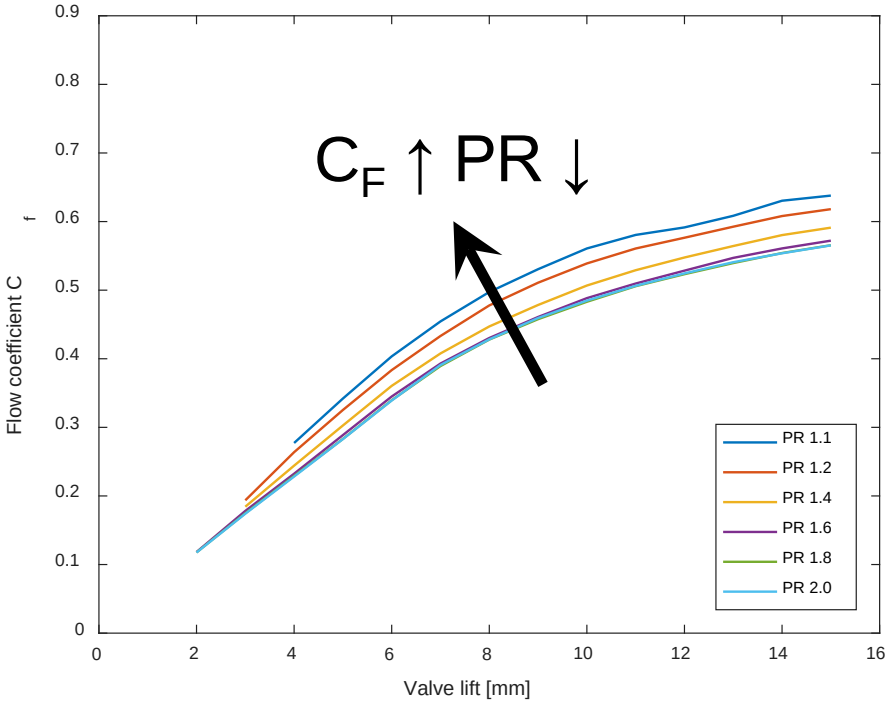
- Case summary

Case	A1	A2	B1	B2
Cylinder head	A		B	
Valve seat angle	45°		30°	
Valve seat inner diameter	35mm		35.5mm	
Cylinder bore	127mm		130mm	
No. exhaust valves	1	2	1	2

Results – single valve

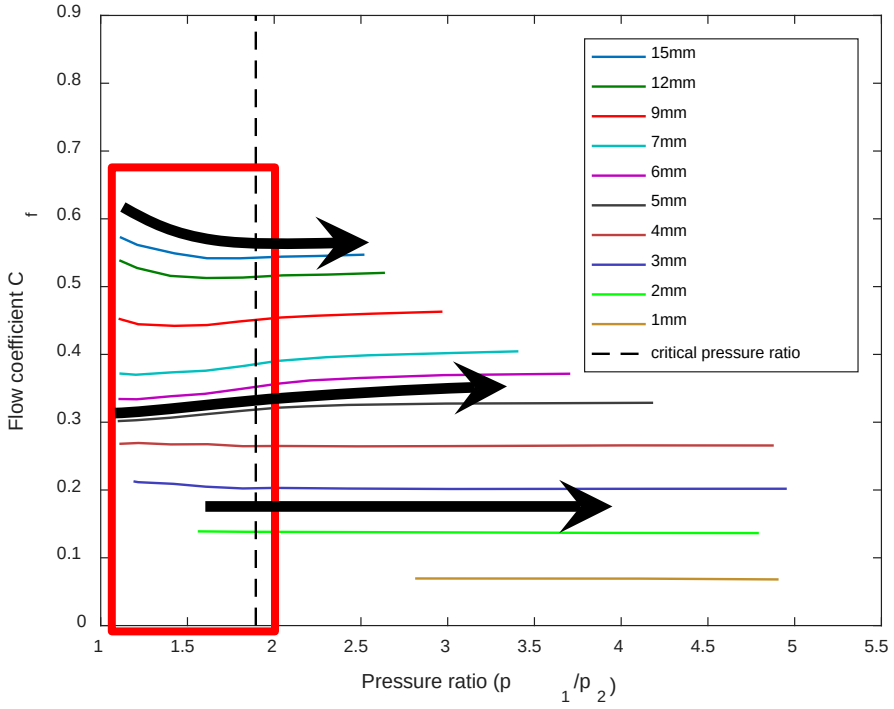
- 45° valve seat angle

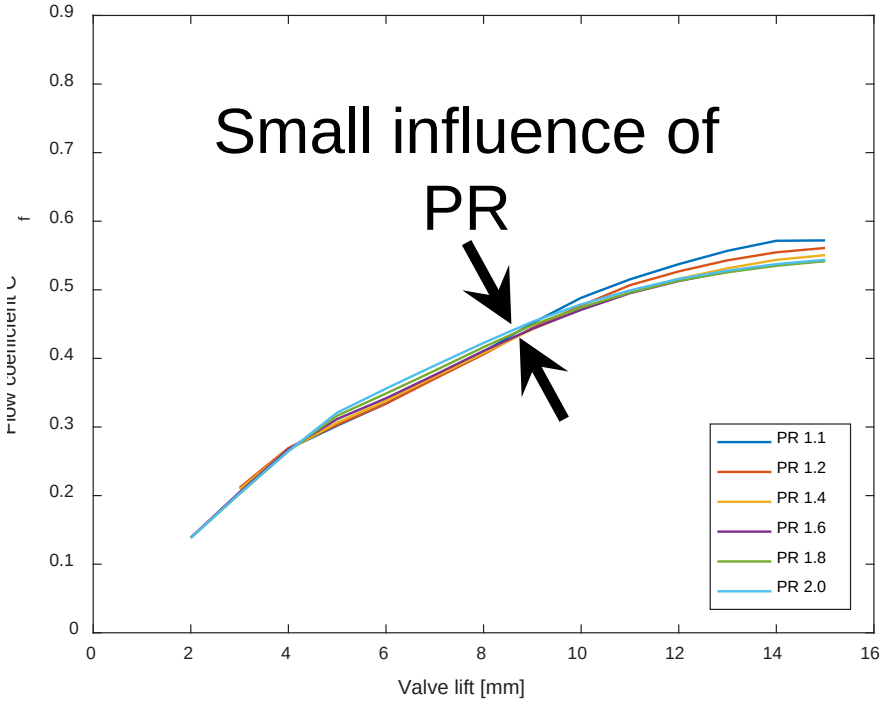




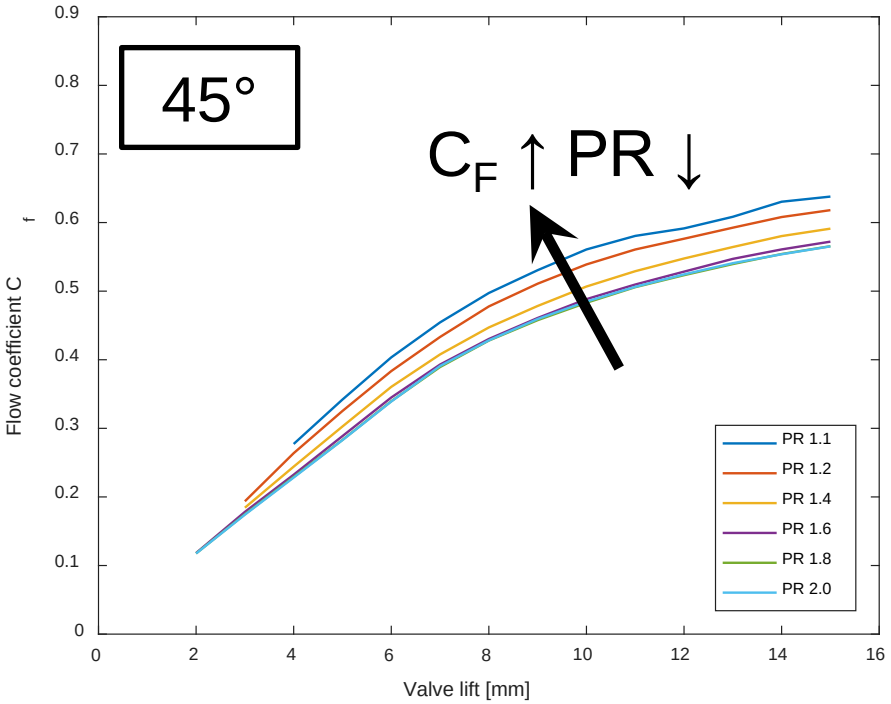
Results – single valve

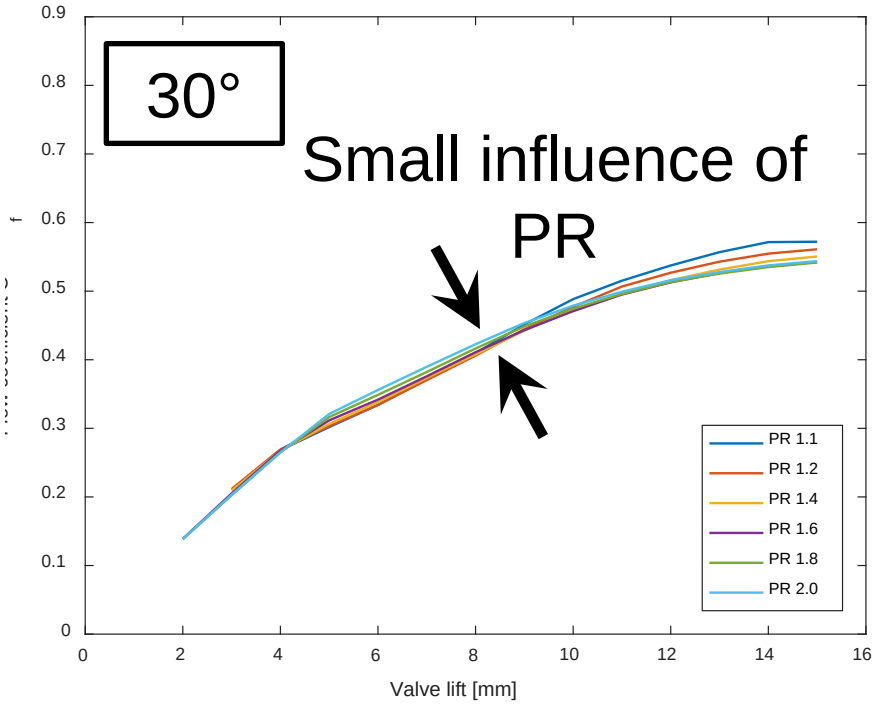
- 30° valve seat angle





Results – Comparison single valve





- **1-D modelling assumption of constant exhaust valve C_F found to be questionable**
  - Pressure ratio influence the C_F .
  - C_F varies with geometry

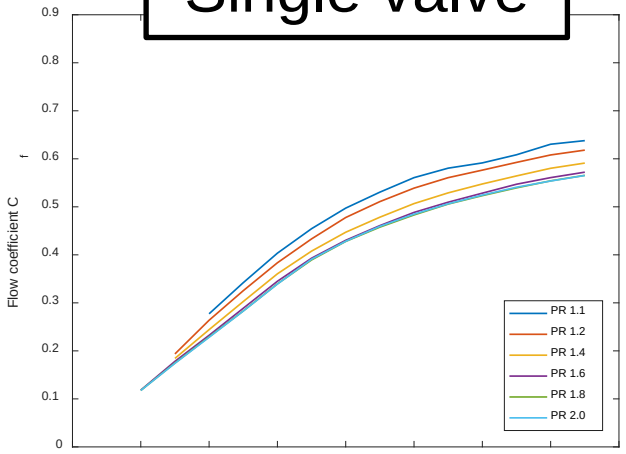
Results – Comparison single vs twin valve

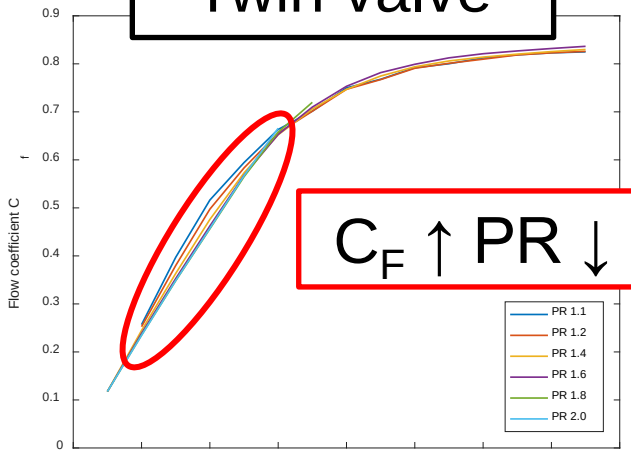
Single valve

Twin valve

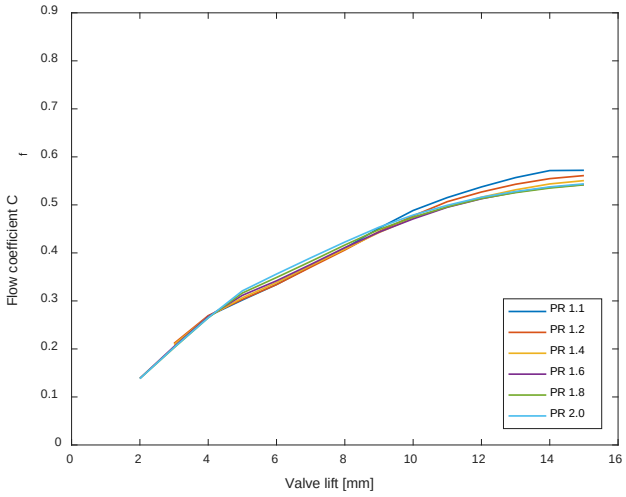
45°

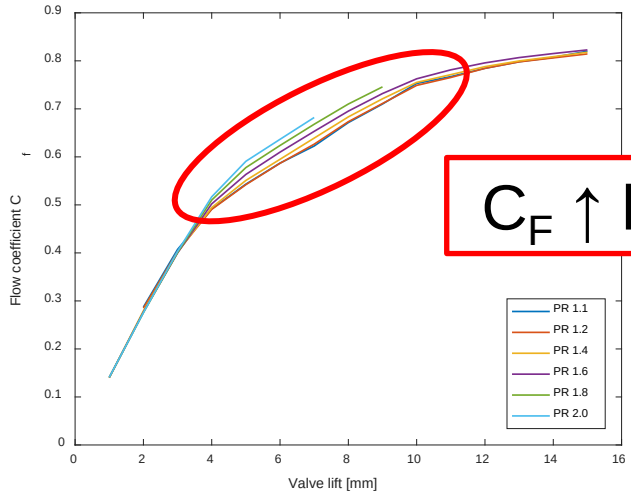
30°





$C_F \uparrow PR \downarrow$





$C_F \uparrow PR \uparrow$

- **1-D modelling assumption of similar behavior of single and twin valves found to be questionable**
  - A single valve behaves differently than twin valves

Conclusions

- **1-D modelling assumption of constant exhaust valve C_F found to be questionable**
  - Pressure ratio influence the C_F
  - C_F varies with geometry

- **1-D modelling assumption of similar behavior of single and double valves found to be questionable**
  - A single valve behaves differently than twin valves

- **Conclusions from draft “17PFL-0905” submitted for SAE world congress**

- Questions?

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