基于KULI的发动机热管理软件平台研究

Research on engine thermal management platform base on KULI

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MAGNA

1. 热管理平台的意义
   The definition of thermal management platform

2. 研究开发方法
   Research and Develop method

3. 发动机散热试验和模拟
   Engine heat emission experiment and simulation

4. 发动机热管理台架试验和模拟
   Engine thermal management testbench experiment and simulation

5. 散热器、风扇等零部件对冷却系统的影响
   Cooling system component influence

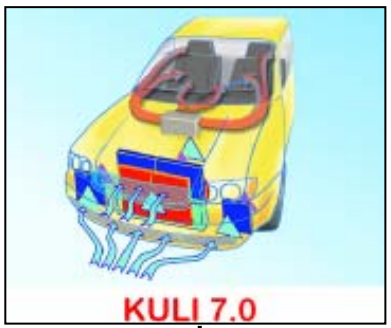
6. 总结和展望
   Conclusion & outlook

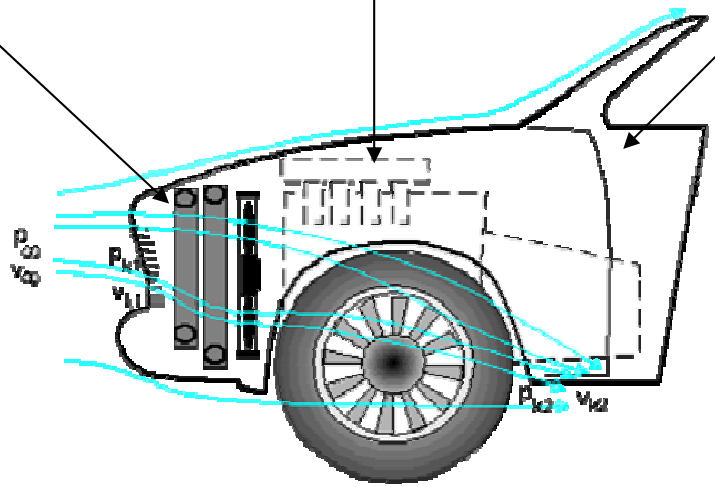
1.热管理平台的意义
The definition of thermal management platform

冷却系统
Cooling System

发动机
Engine

整车
Vehicle





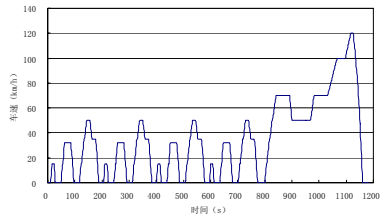
Intake and Exit of the Cooling Air

发动机与整车热管理平台开发研究
Engine and Vehicle Thermal Management Platform

2.研究开发方法
Start up of research

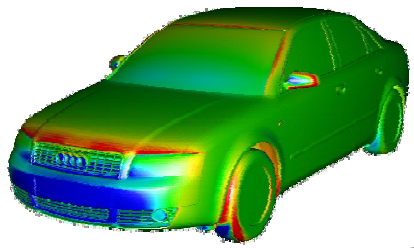
发动机

Engine



行驶工况

Driving

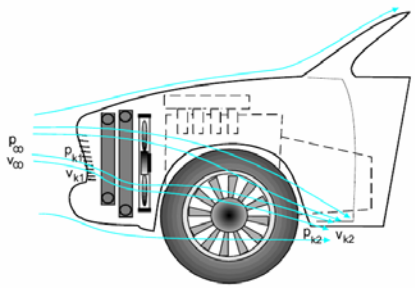


整车

Vehicle

冷却系统

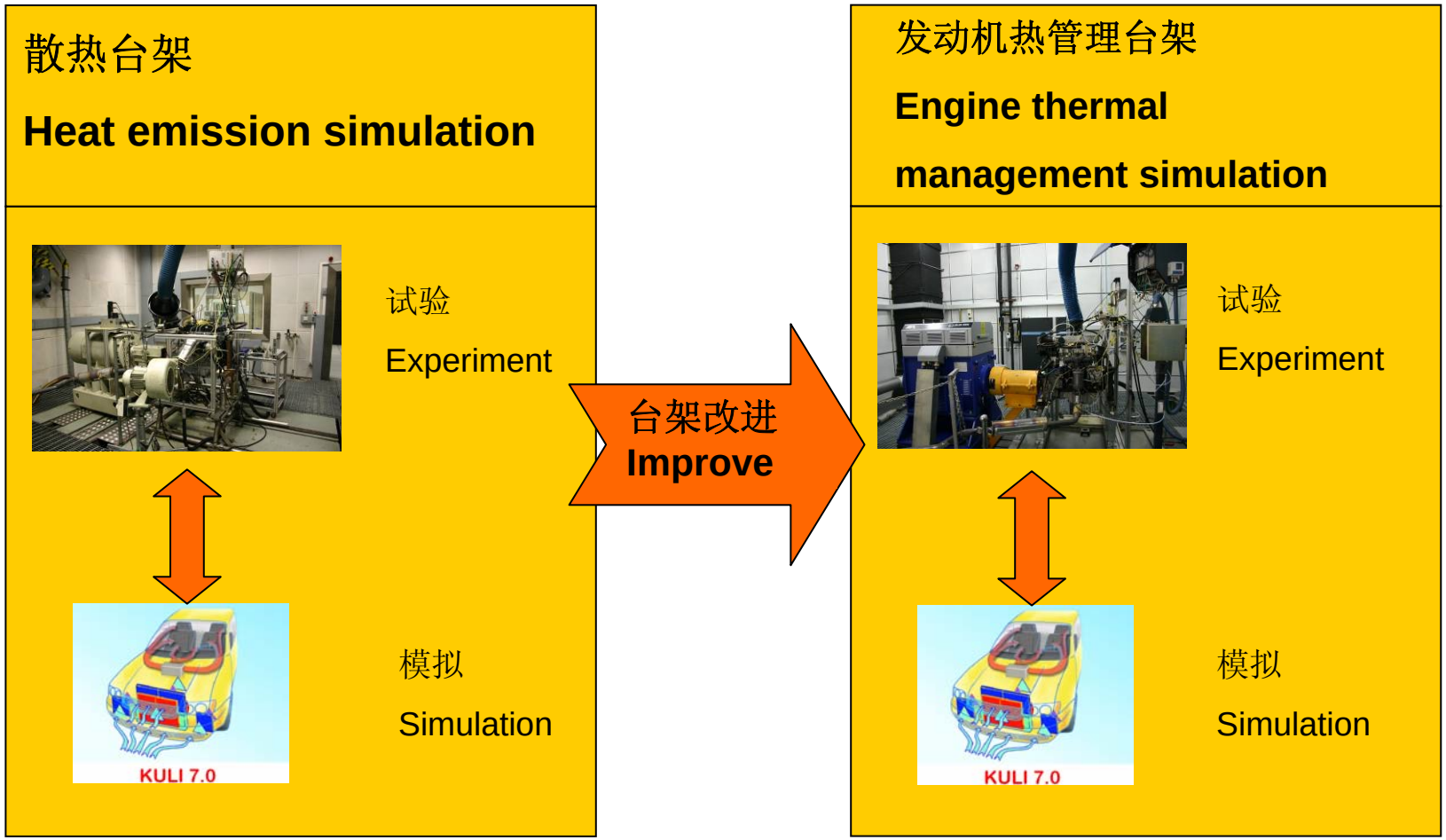
Cooling system



空气流路

Air flow

2.研究开发方法
Start up of research

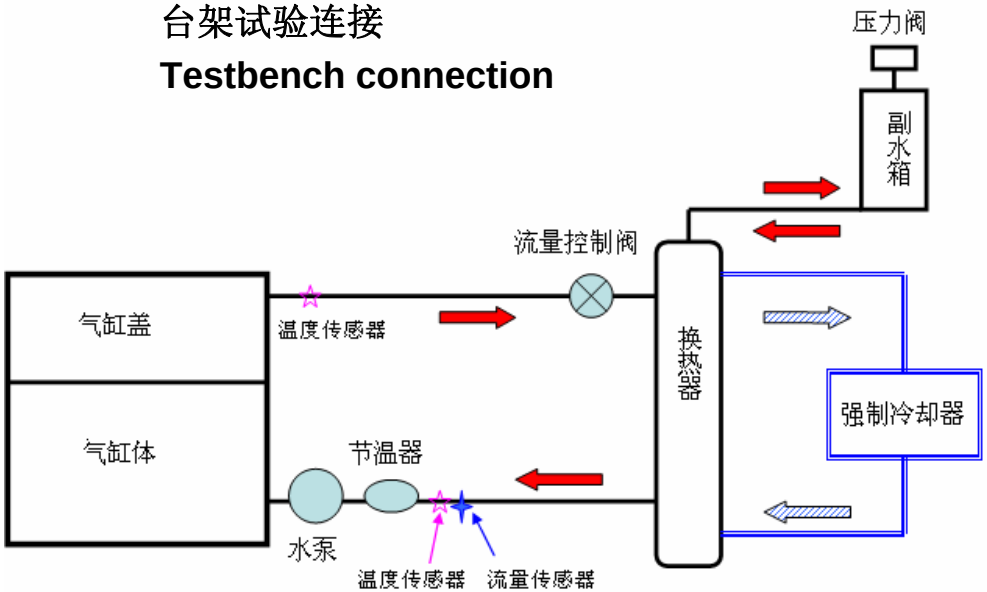


3.发动机散热试验和模拟
Engine heat emission experiment and simulation

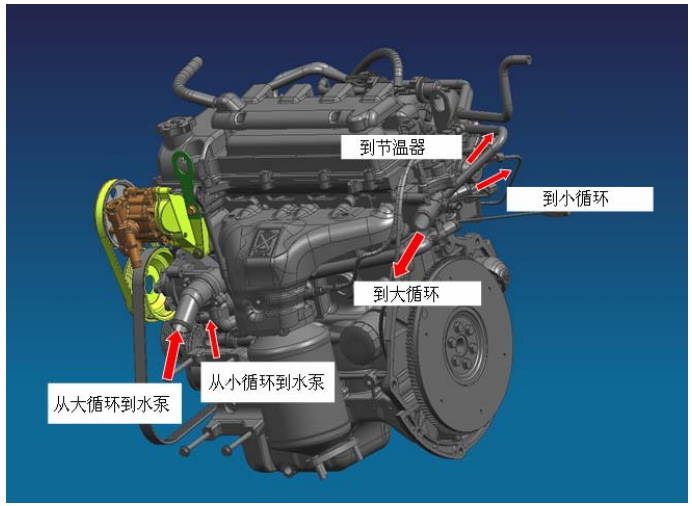
台架改造Testbench modification：

- ✓ 取消小循环 Cancel small circulation
- ✓ 以外部强制冷却器代替冷却系统 Use force water cooler
- ✓ 保证发动机出口冷却液温度为90℃ Ensure engine coolant outlet 90℃

台架试验连接
Testbench connection



发动机数模和冷却液主要进出口
Main coolant flow



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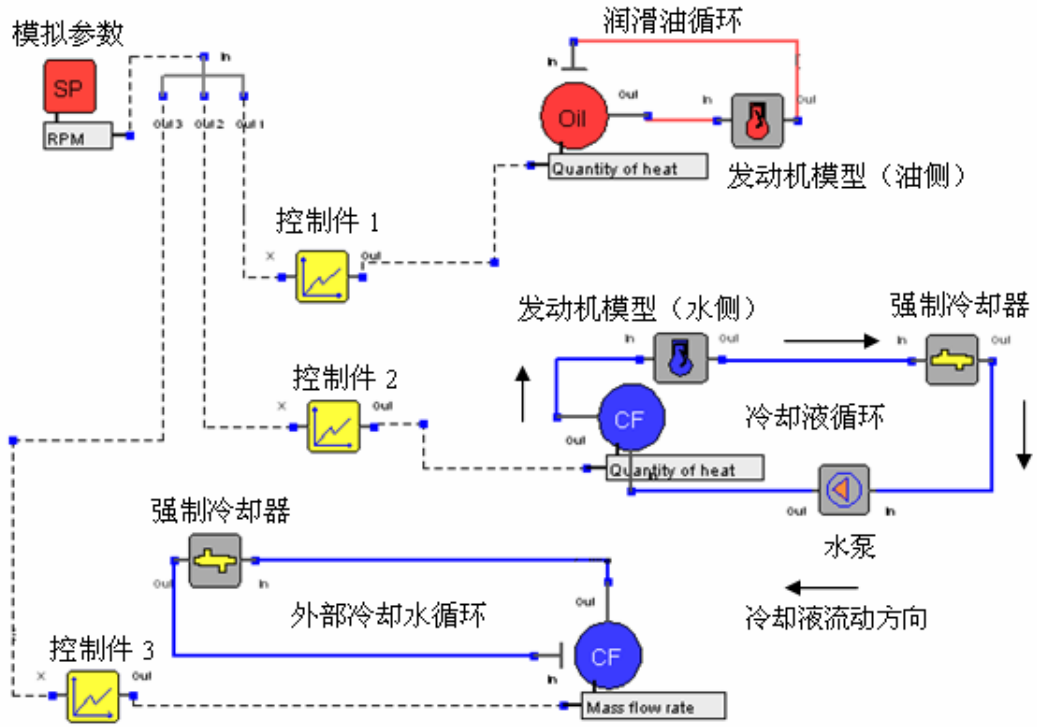
KULI模拟

KULI Simulation：

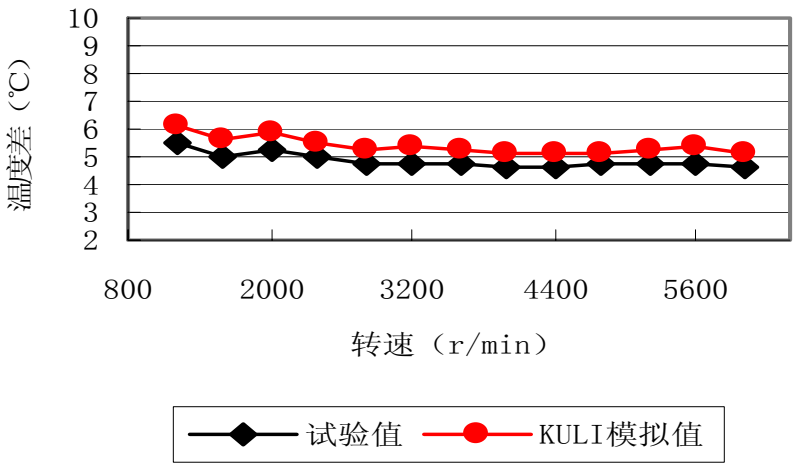
- ✓ 发动机出口冷却液温度与试验值保持一致
- ✓ Coolant outlet temperature the same as experiment

- ✓ 考察发动机入口温度、热量
- ✓ Consider inlet temperature, heat



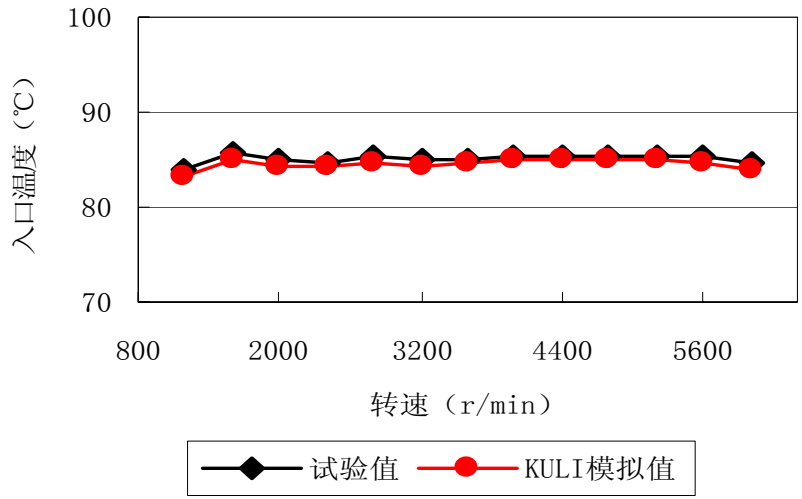
3.发动机散热试验和模拟
Engine heat emission experiment and simulation

发动机散热台架模拟结果 Simulation result



发动机进出口温度差

Engine inlet and outlet temperature difference



发动机入口冷却液温度

Engine coolant inlet temperature

4.发动机热管理台架试验和模拟
Engine thermal management testbench experiment and simulation

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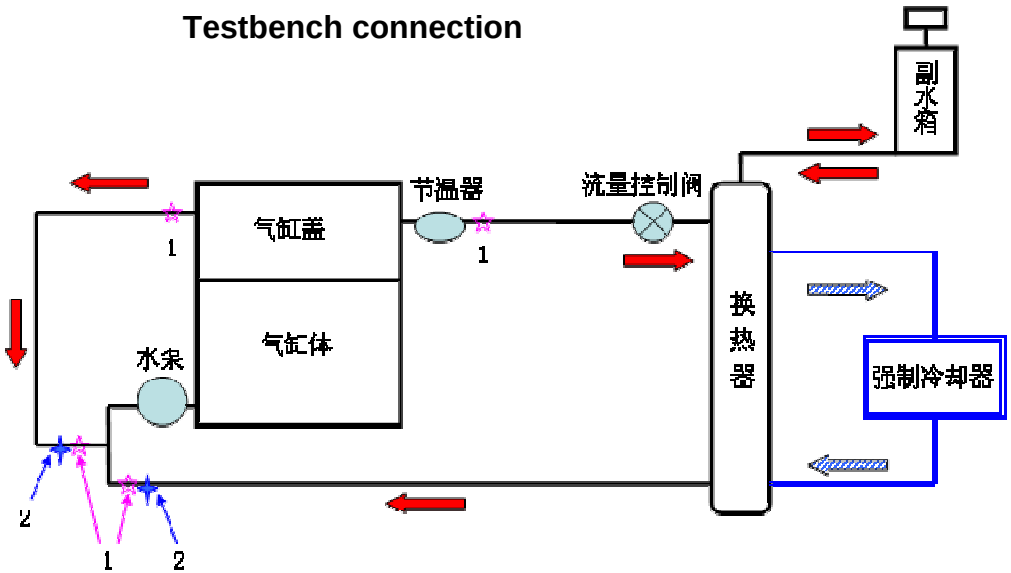
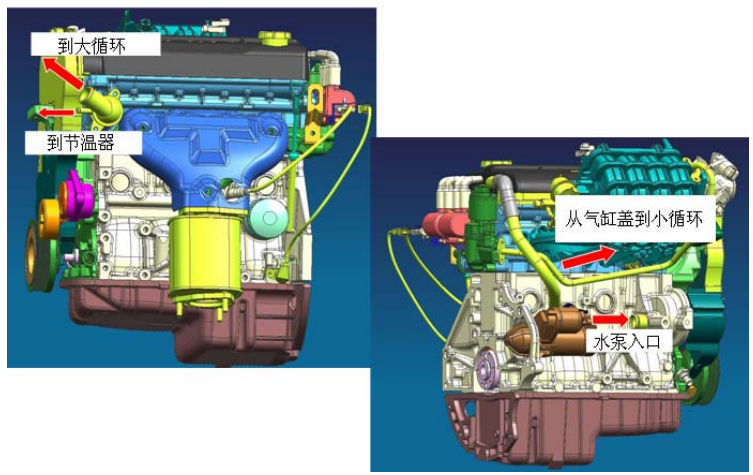


发动机数模和冷却液主要进出口
Main coolant flow



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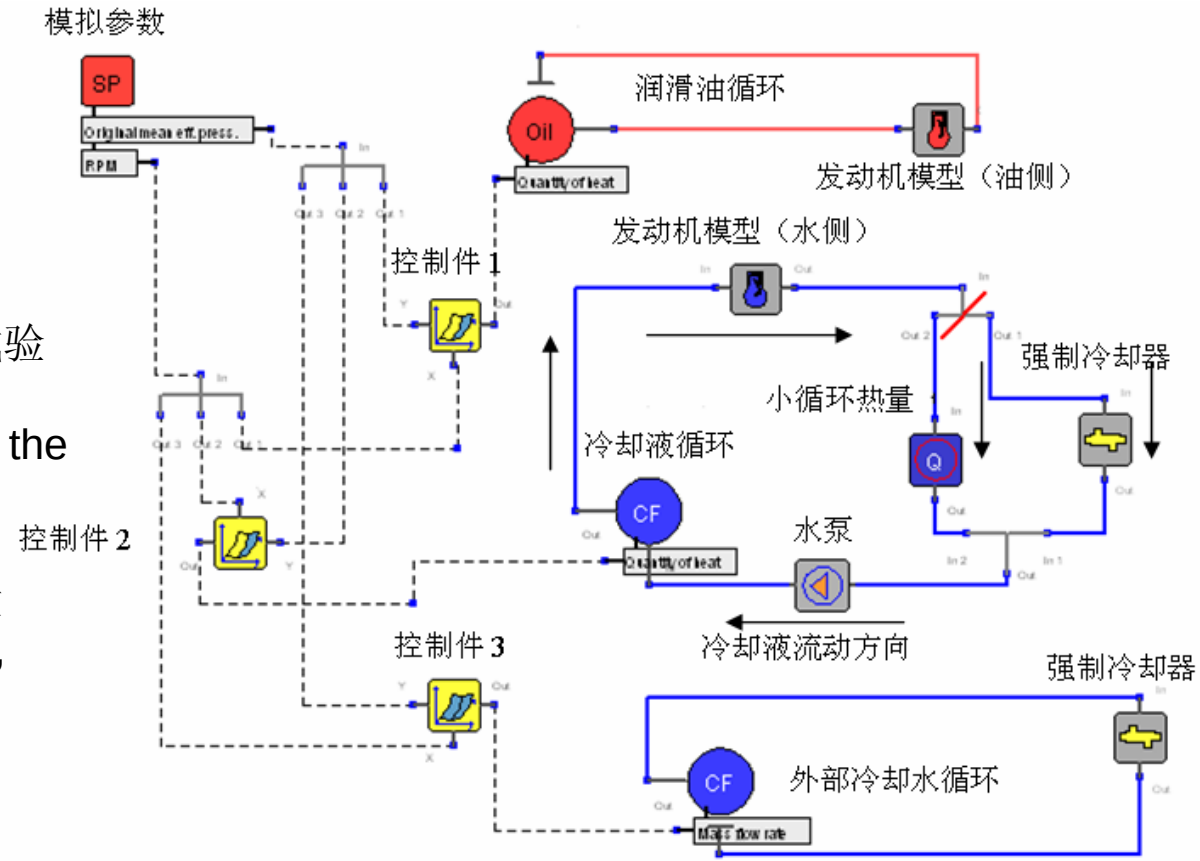
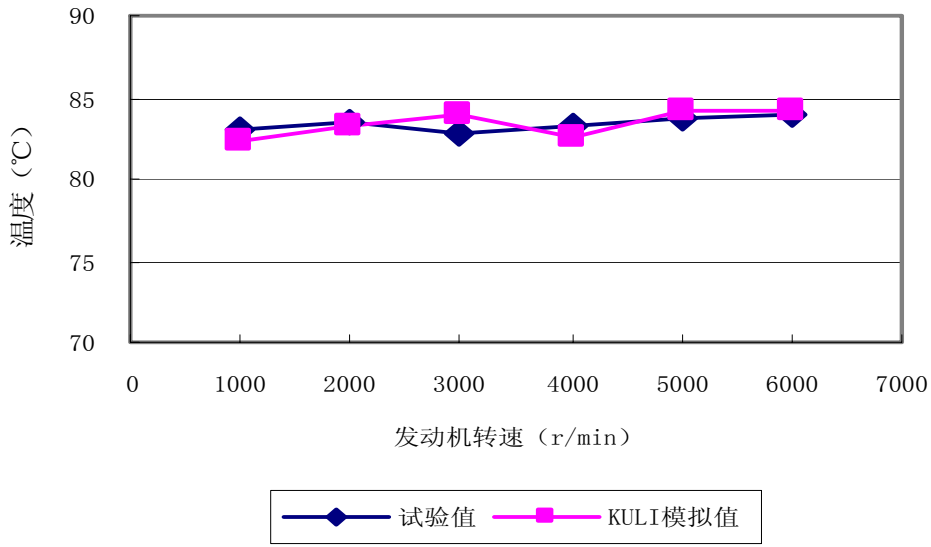
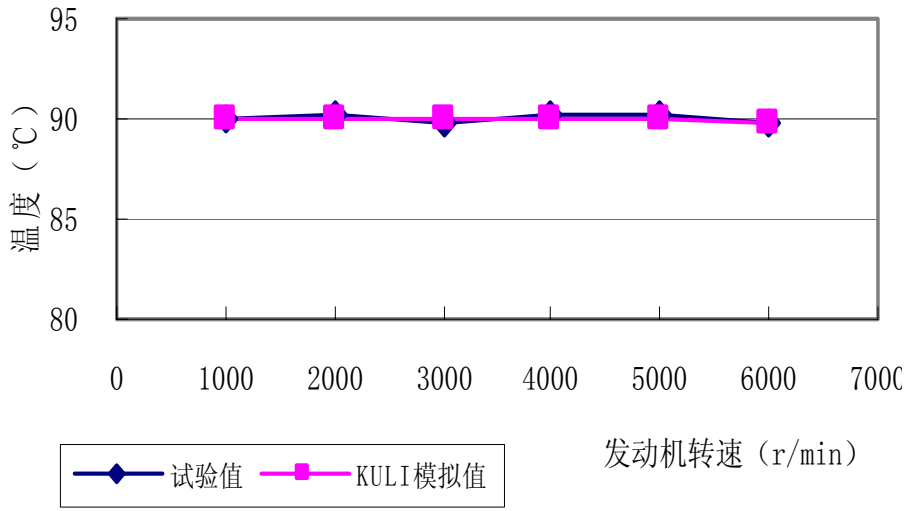


4.发动机热管理台架试验和模拟
Engine thermal management testbench experiment and simulation

发动机热管理台架模拟结果 Simulation result



大循环发动机冷却液入口温度
Big circulation coolant inlet temperature



大循环发动机冷却液出口温度
Big circulation coolant outlet temperature

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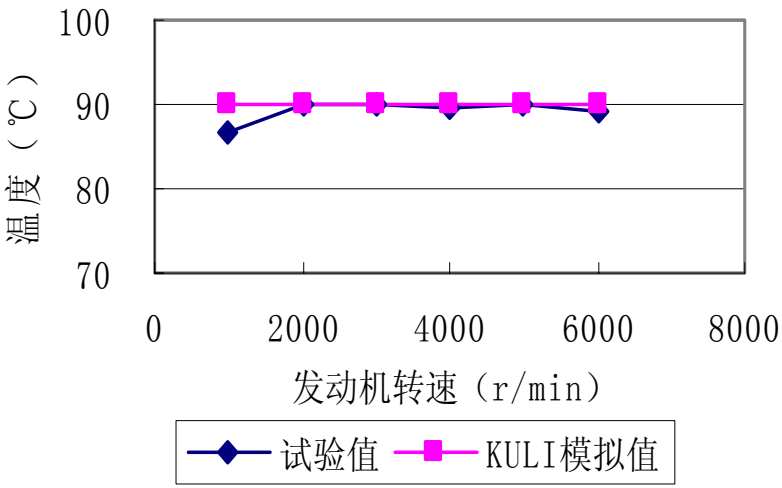
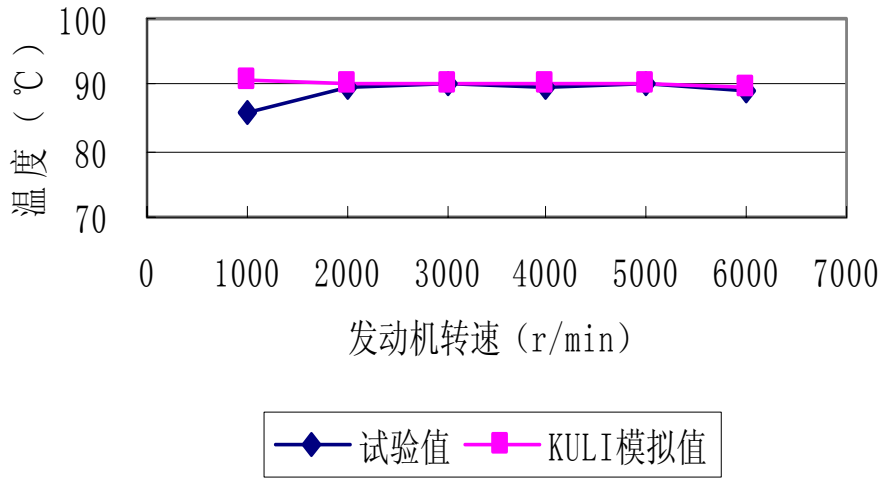
Engine thermal management testbench experiment and simulation

发动机热管理台架模拟结果 Simulation result



小循环发动机冷却液出口温度
Small circulation coolant outlet temperature



小循环发动机冷却液入口温度
Small circulation coolant inlet temperature

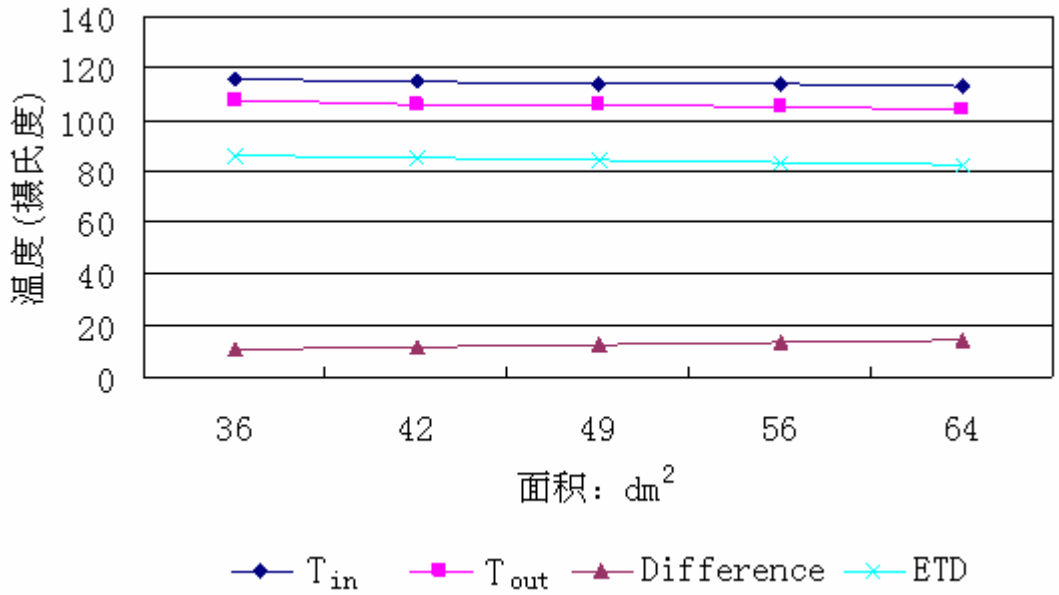
5.散热器、风扇等零部件对冷却系统的影响
Cooling system component influence

5.1 散热器尺寸对冷却效果的影响
Radiator size influence

散热器尺寸
Radiator size

1	600mm×600mm
2	700mm×600mm
3	700mm×700mm
4	800mm×700mm
5	800mm×800mm

关键温度变化
Key temperature

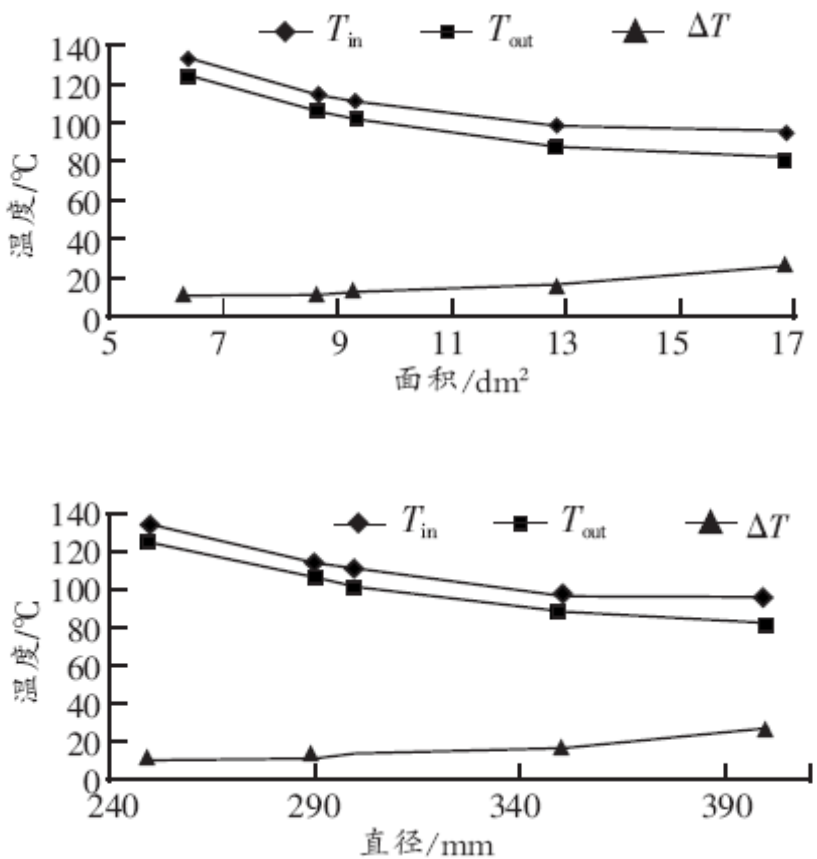


5.散热器、风扇等零部件对冷却系统的影响
Cooling system component influence

5.2 风扇尺寸对冷却效果的影响
Fan influence

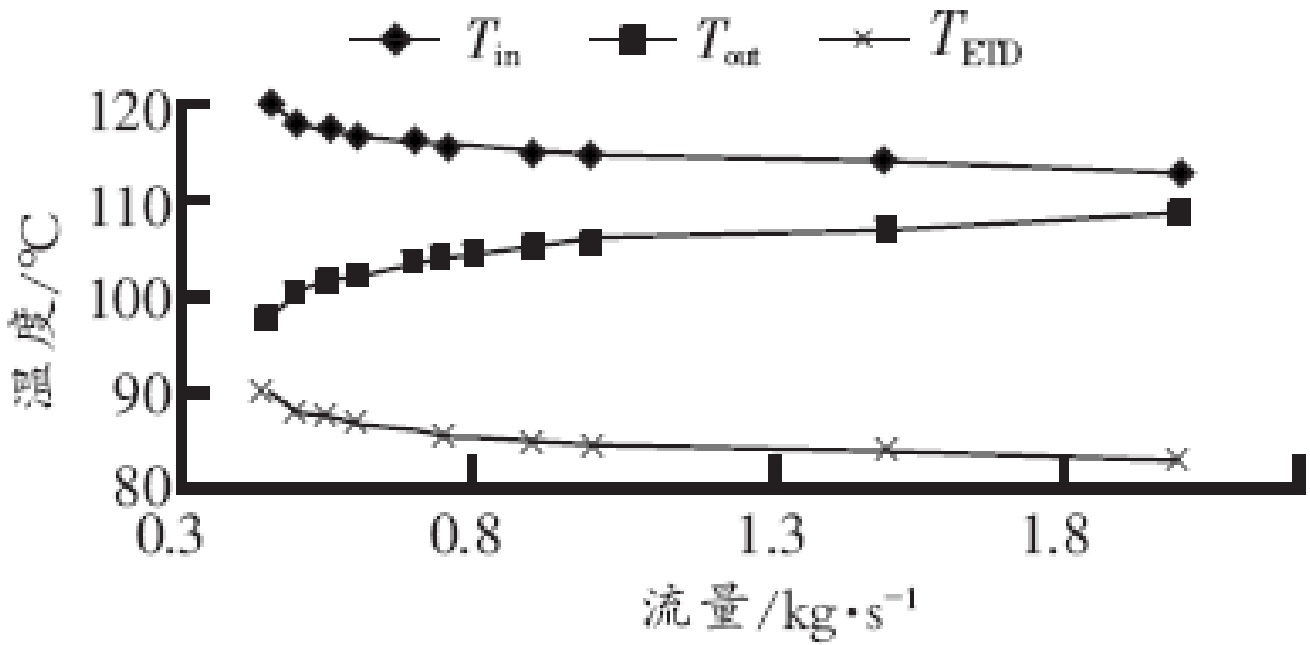
风扇直径
Fan diameter

1	250mm
2	290mm
3	300mm
4	350mm
5	400mm



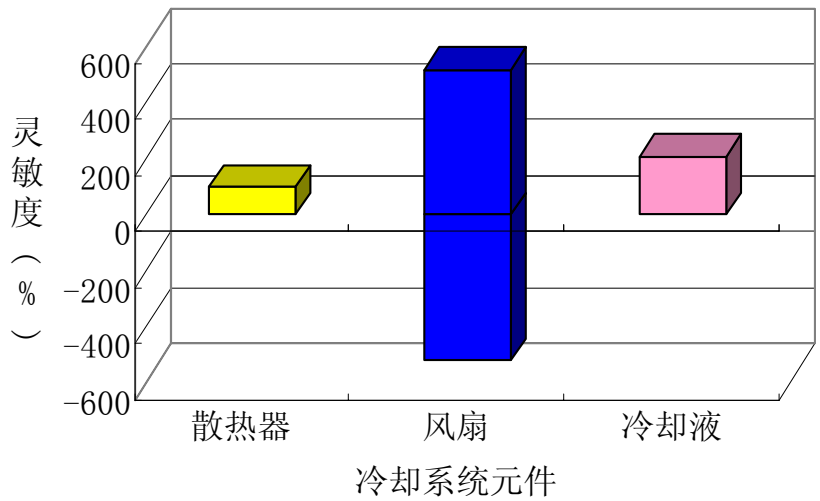
5.散热器、风扇等零部件对冷却系统的影响
Cooling system component influence

5.3 冷却液流量对冷却效果的影响
Coolant mass flow influence



5.散热器、风扇等零部件对冷却系统的影响
Cooling system component influence

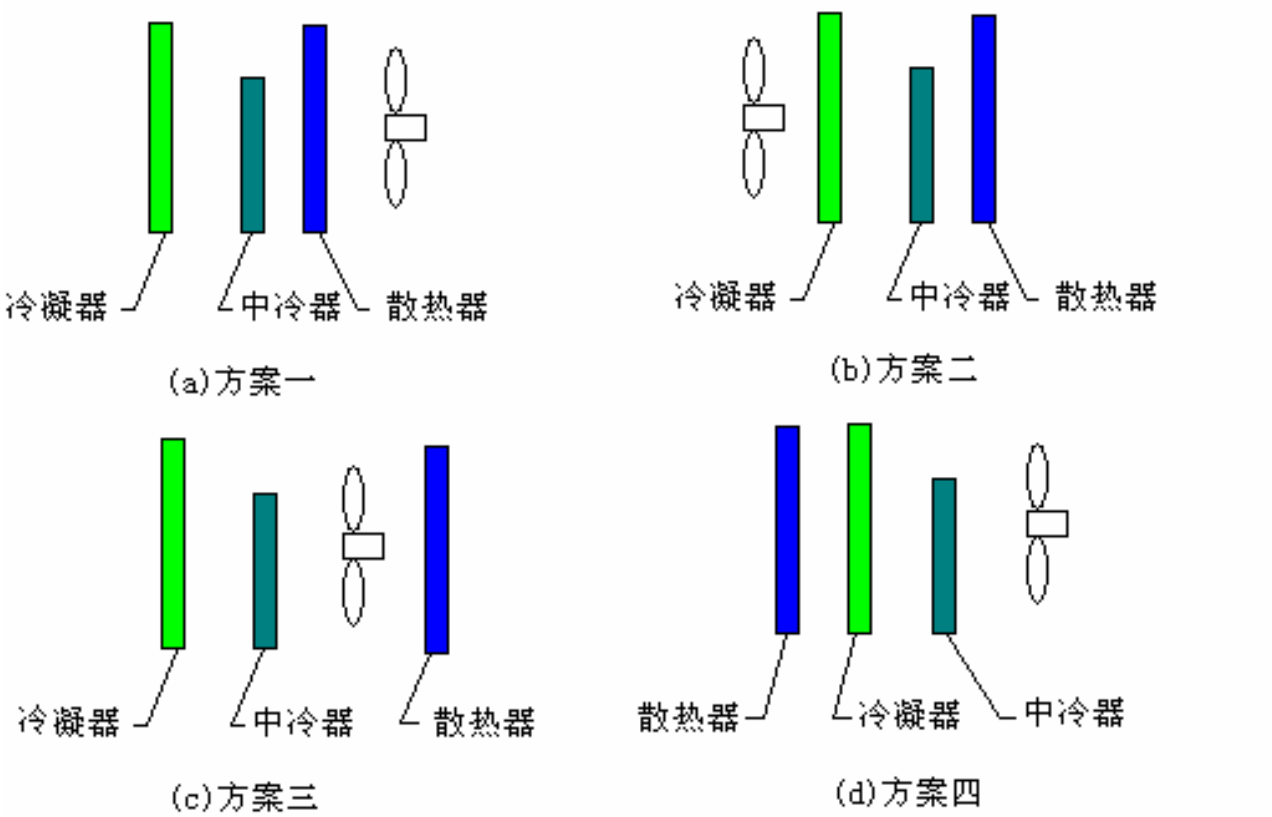
5.4 灵敏度分析
Sensitivity Analysis



	min T_{out} /℃	max T_{out} /℃	min %	max %
散热器	112.91	116.19	0	100
风扇	95.73	133.27	-523	518
冷却液流量	112.81	119.79	-3	210

5.散热器、风扇等零部件对冷却系统的影响
Cooling system component influence

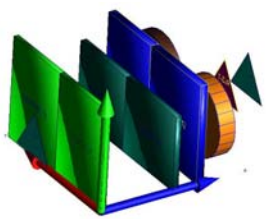
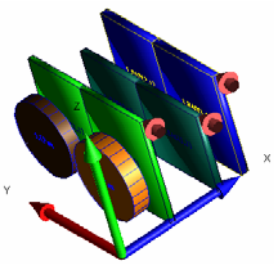
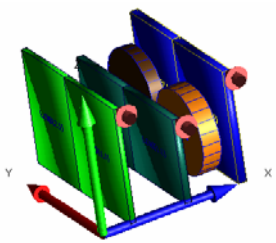
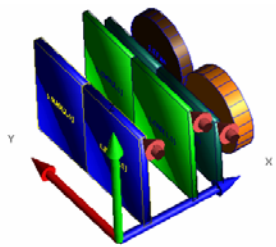
5.5 不同冷却系统布置方案
Cooling system layout



5.散热器、风扇等零部件对冷却系统的影响
Cooling system component influence

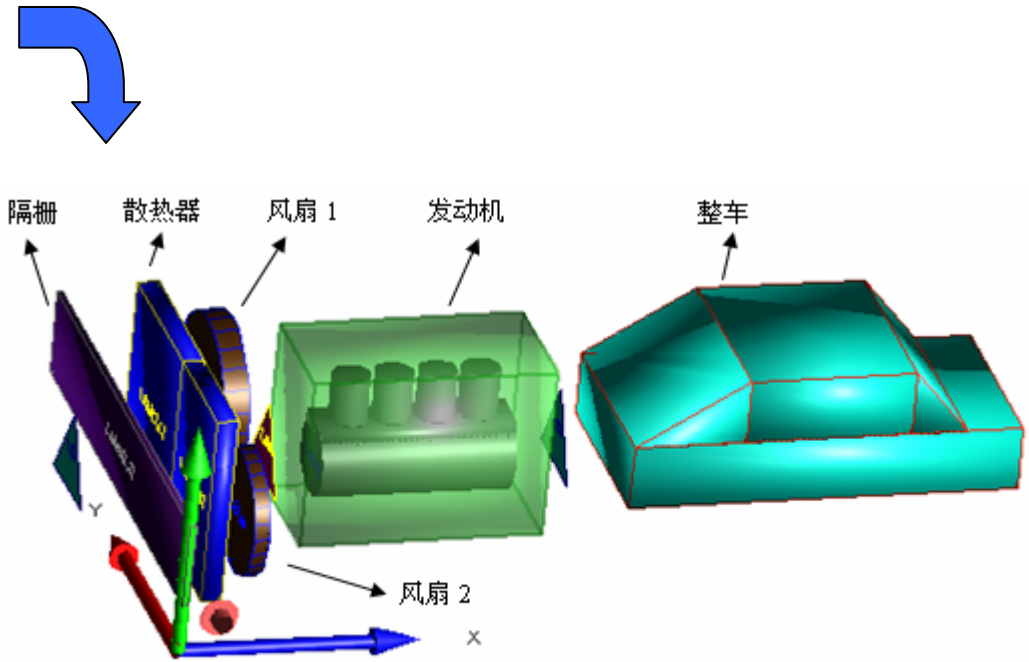
5.5 不同冷却系统布置方案
Cooling system layout

Key temperature influence

	方案 layout 1	方案 layout 2	方案 layout 3	方案 layout 4
散热器进口RAD in（℃）	105.5	106.8	107.8	95.1
散热器出口RAD out（℃）	99.1	100.3	101.4	82.6
中冷器进口CAC in（℃）	84.0	84.0	84.0	84.0
中冷器出口CAC out（℃）	55.4	56.1	56.2	88.8
方案图 Layout				

5.散热器、风扇等零部件对冷却系统的影响
Cooling system component influence

5.6 整车驾驶循环模拟
Driving simulation



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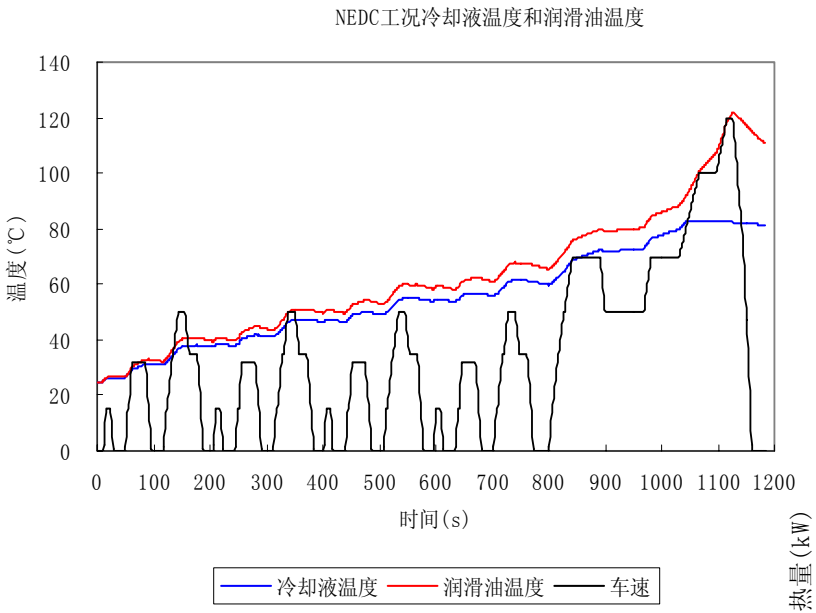

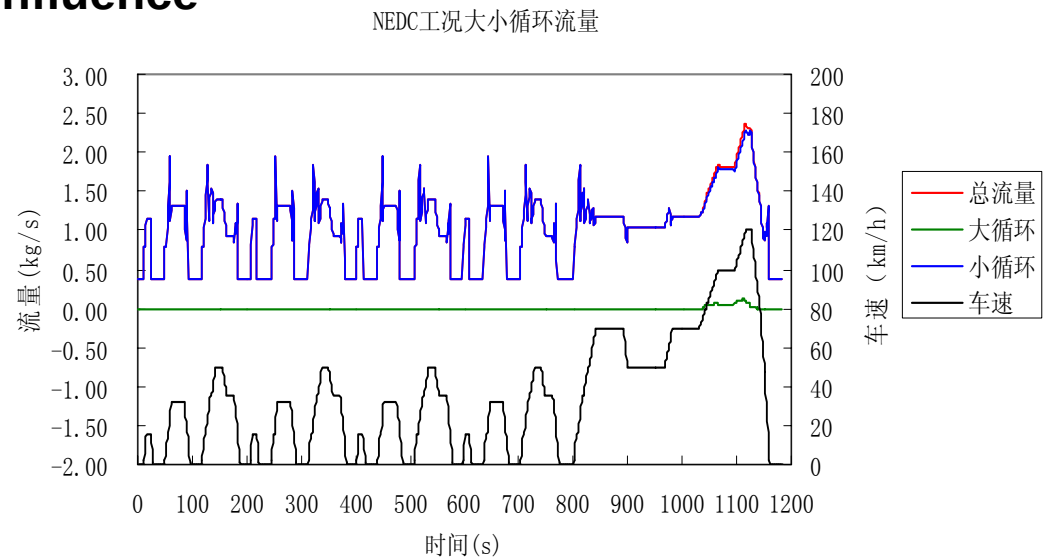

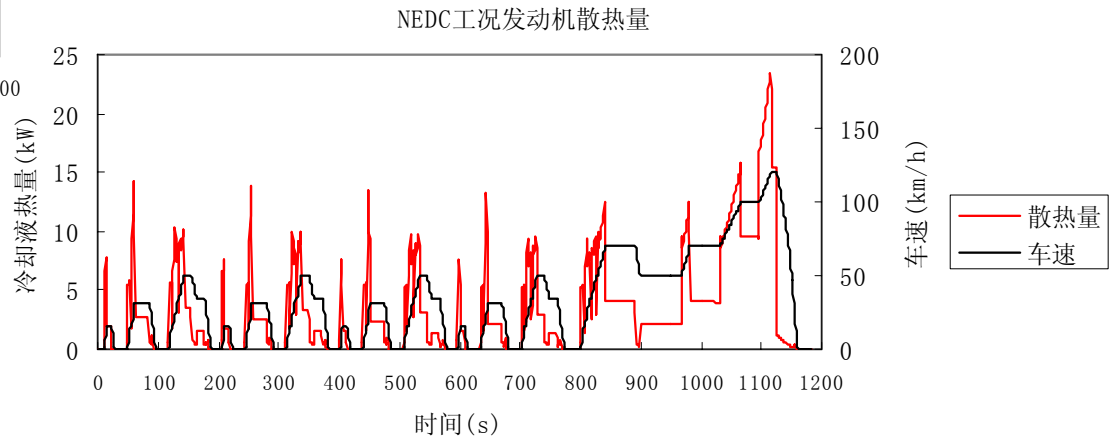

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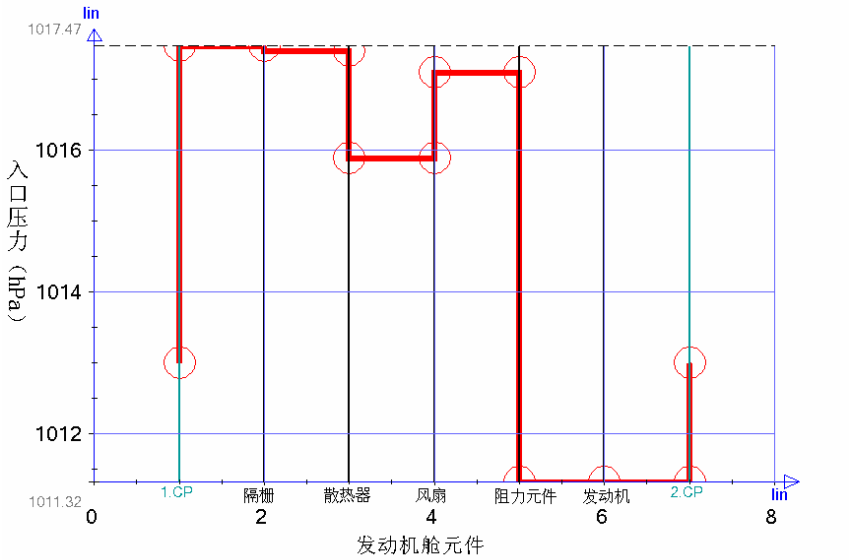
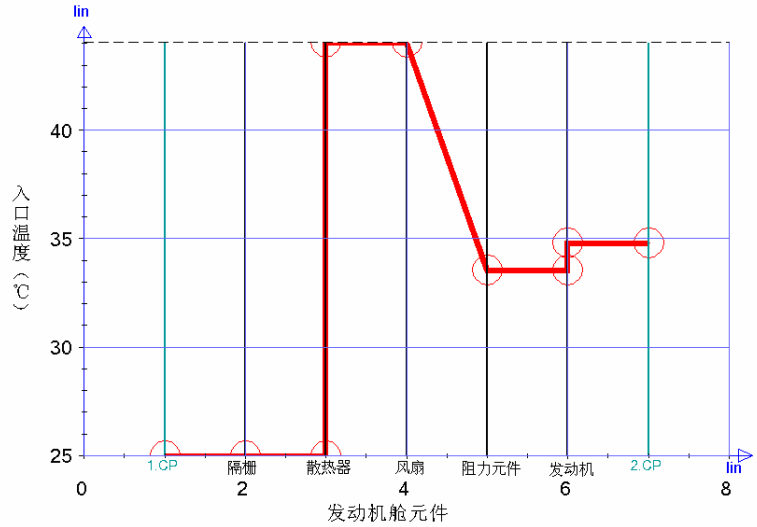


发动机舱压力变化

Engine compartment pressure



发动机舱温度变化

Engine compartment temperature

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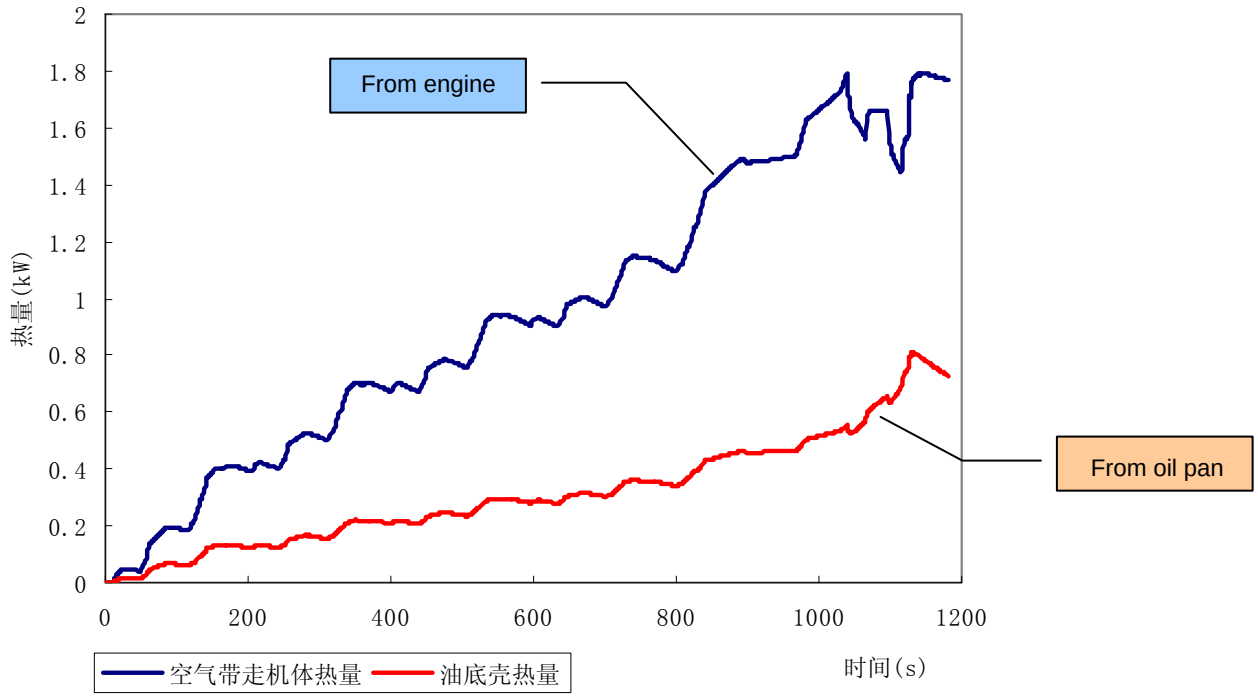


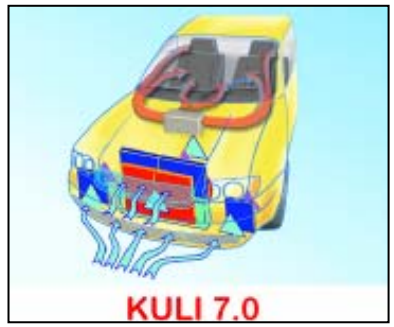
发动机舱热量

Heat from engine compartment

6.总结和展望
Conclusion & outlook

热管理平台

Thermal Management Platform



发动机台架试验模拟

Engine test bench experiment and simulation

零部件选型和优化匹配

Component selection and calibration

整车道路试验和模拟

Vehicle road test and simulation

谢　谢！

Thank you !