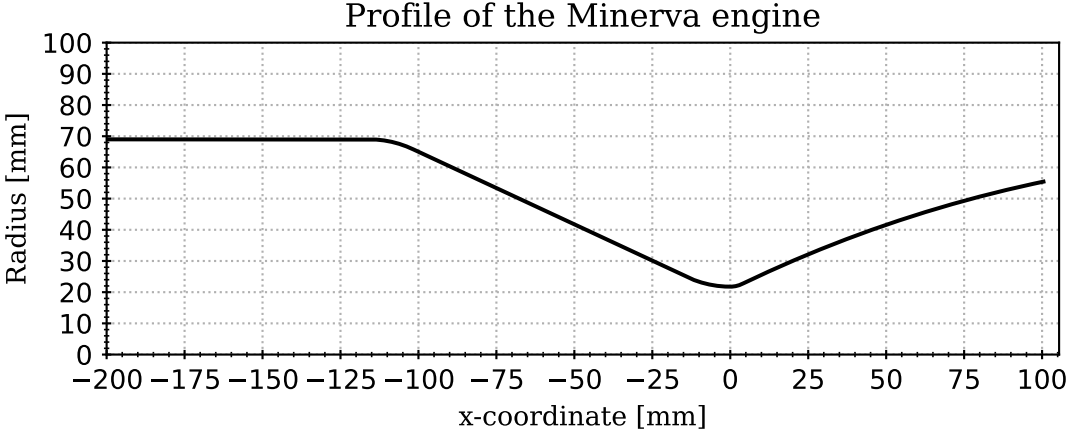
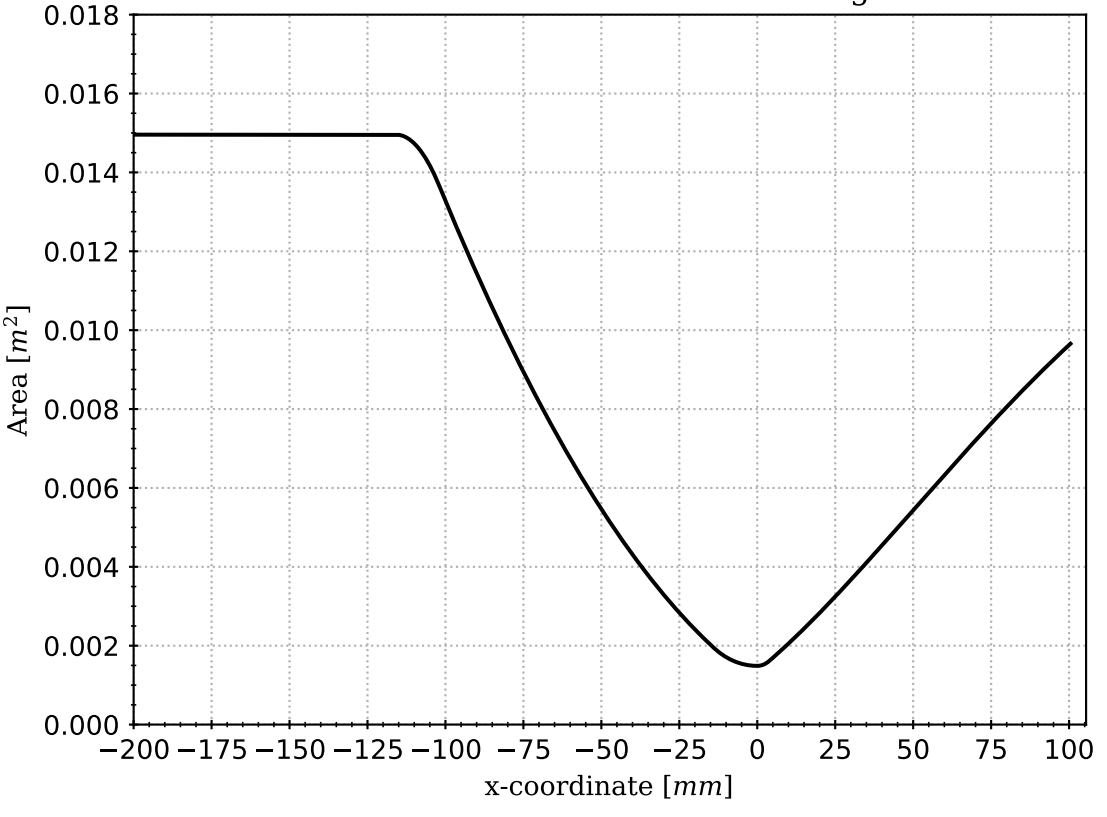
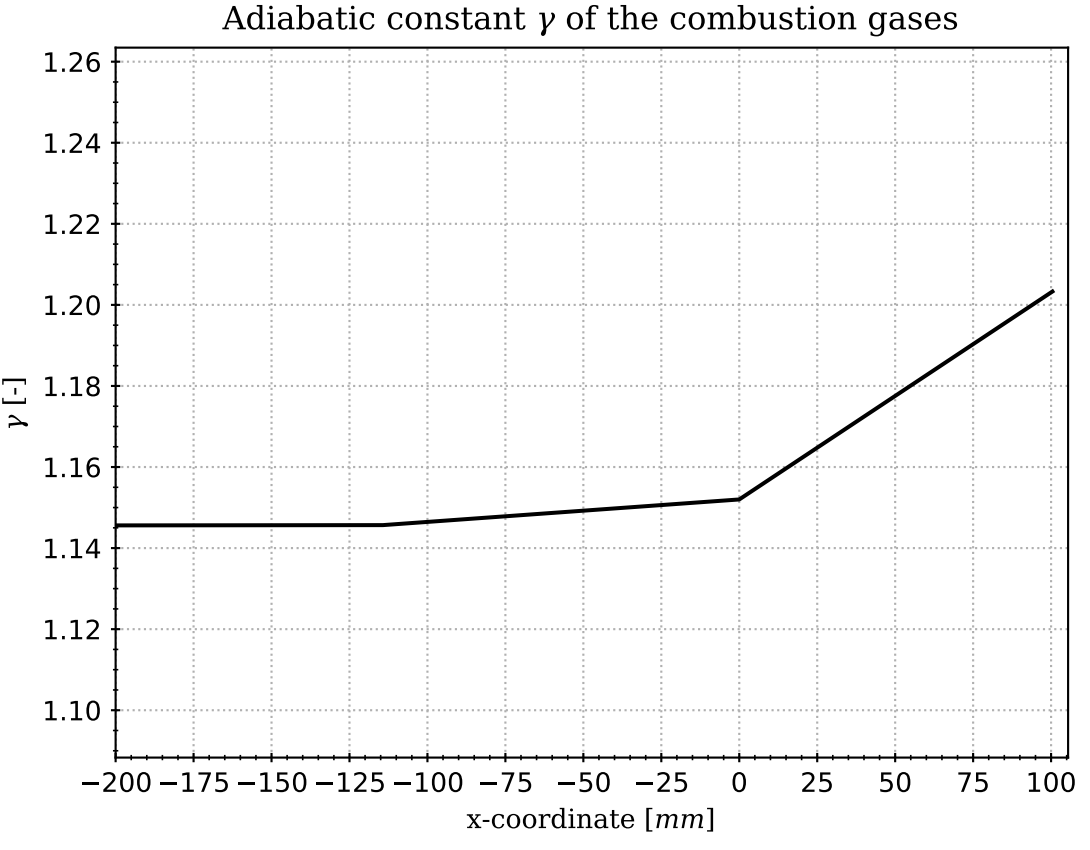
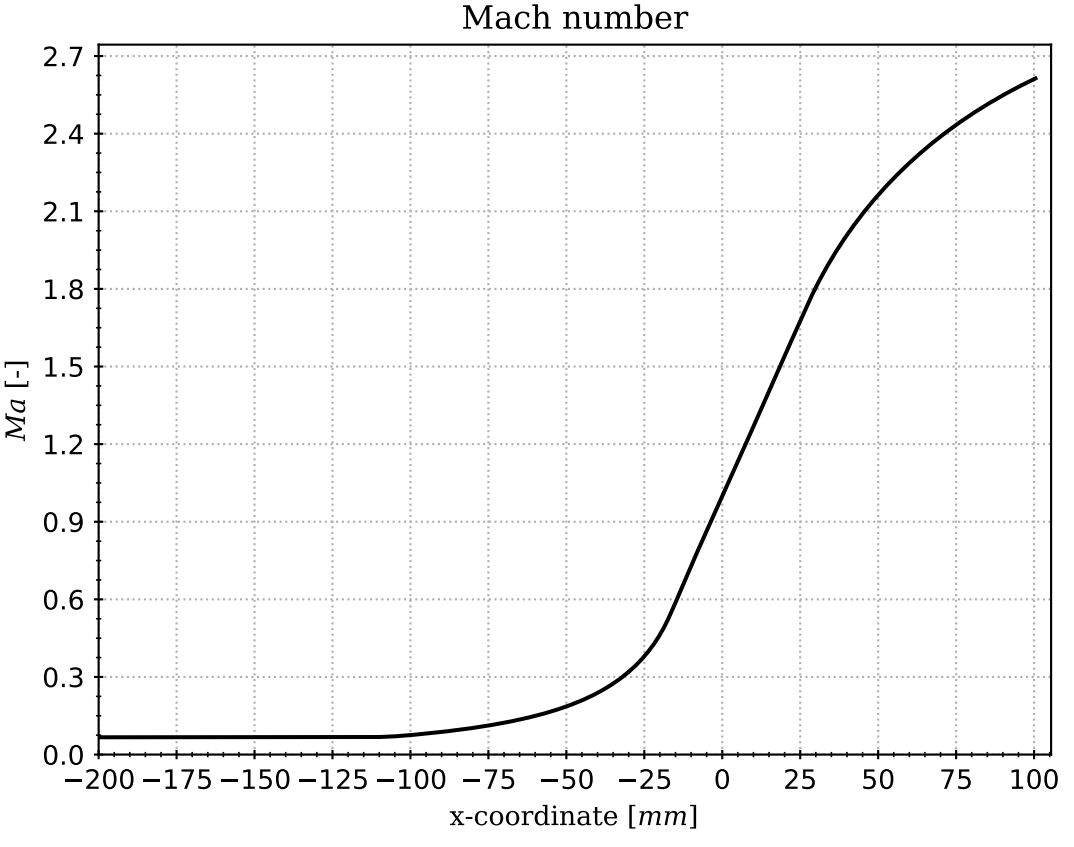
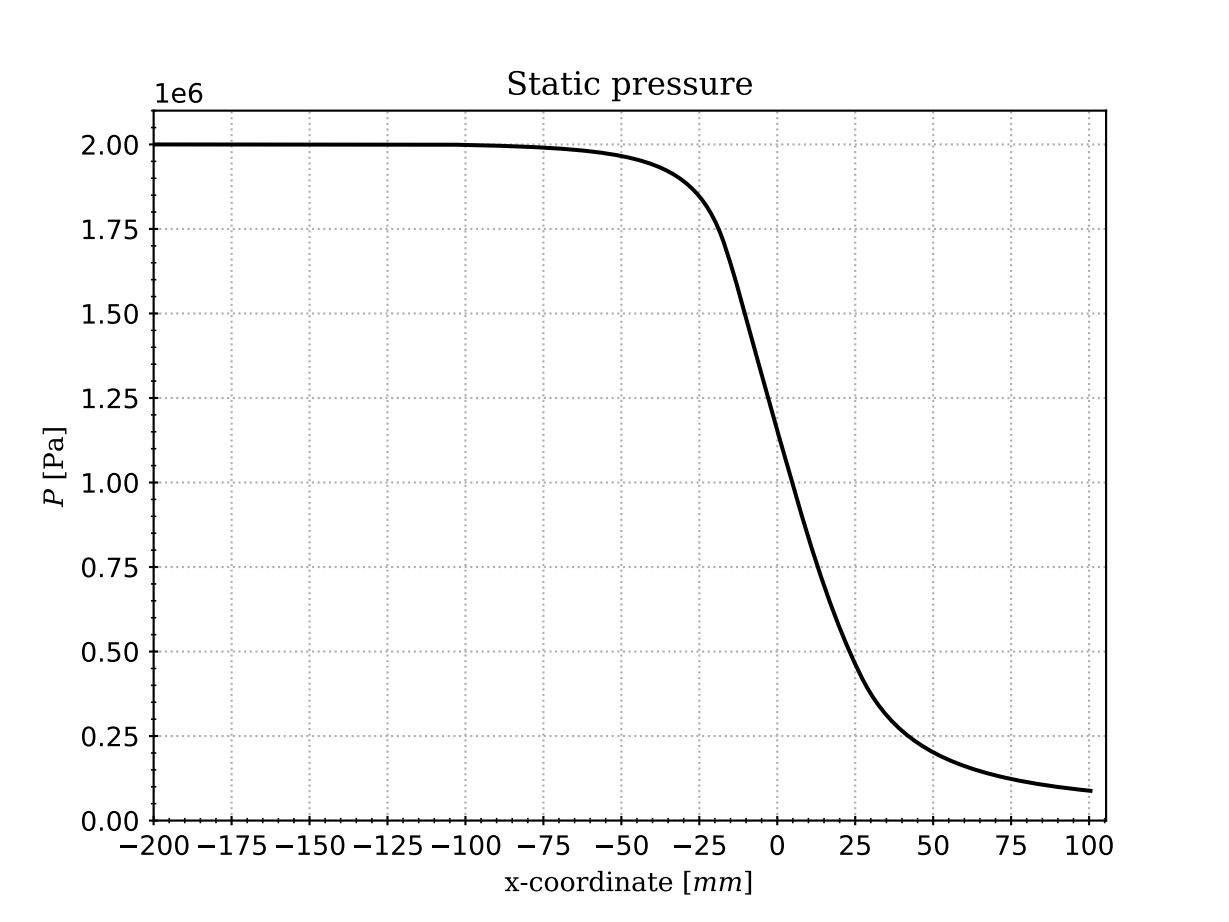
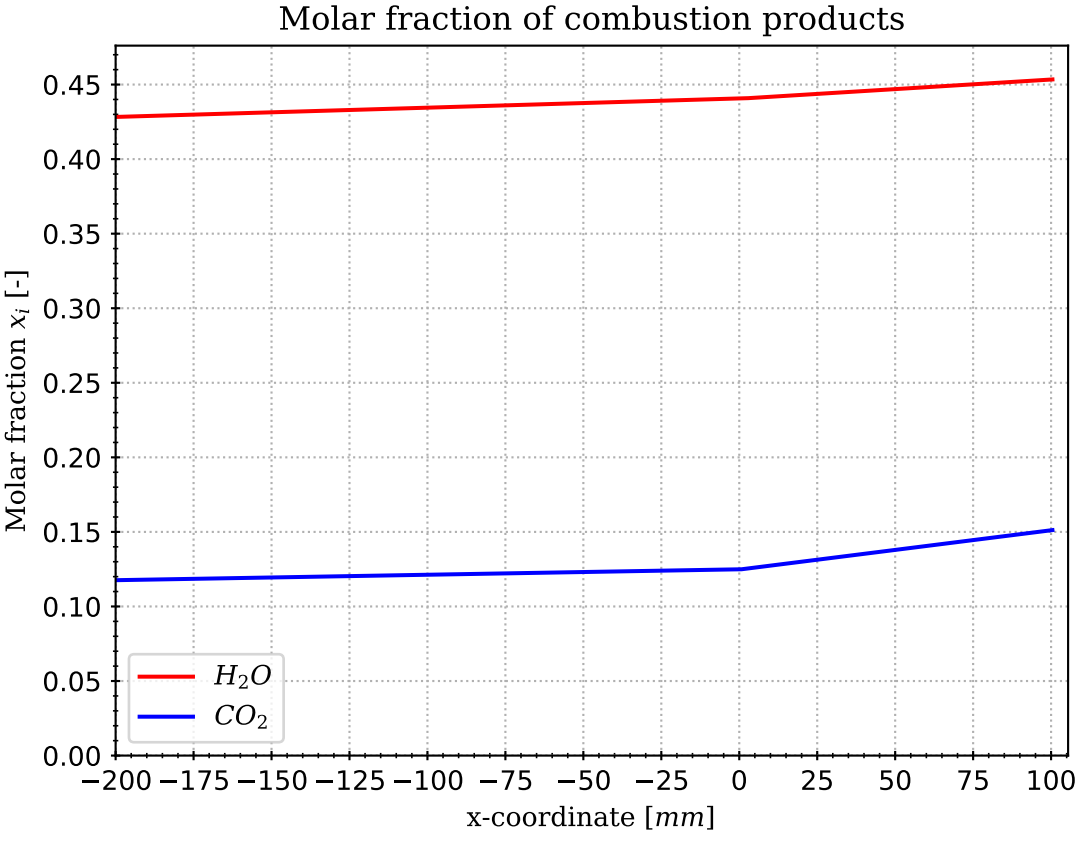

Profile of the Minerva engine
Radius [mm]
x-coordinate [mm]
100
90
80
70
60
50
40
30
20
10
0
−200
−175
−150
−125
−100
−75
−50
−25
0
25
50
75
100

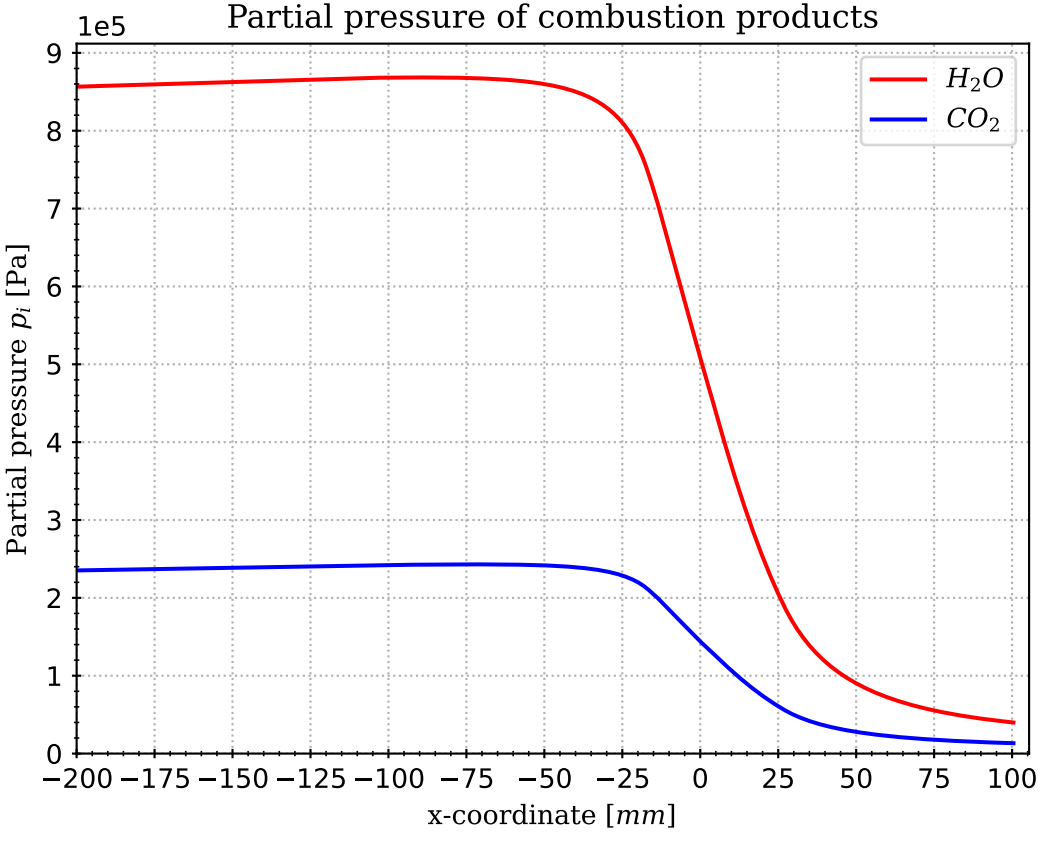

Cross-sectional area inside the engine
Area [m^2]
0.018
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

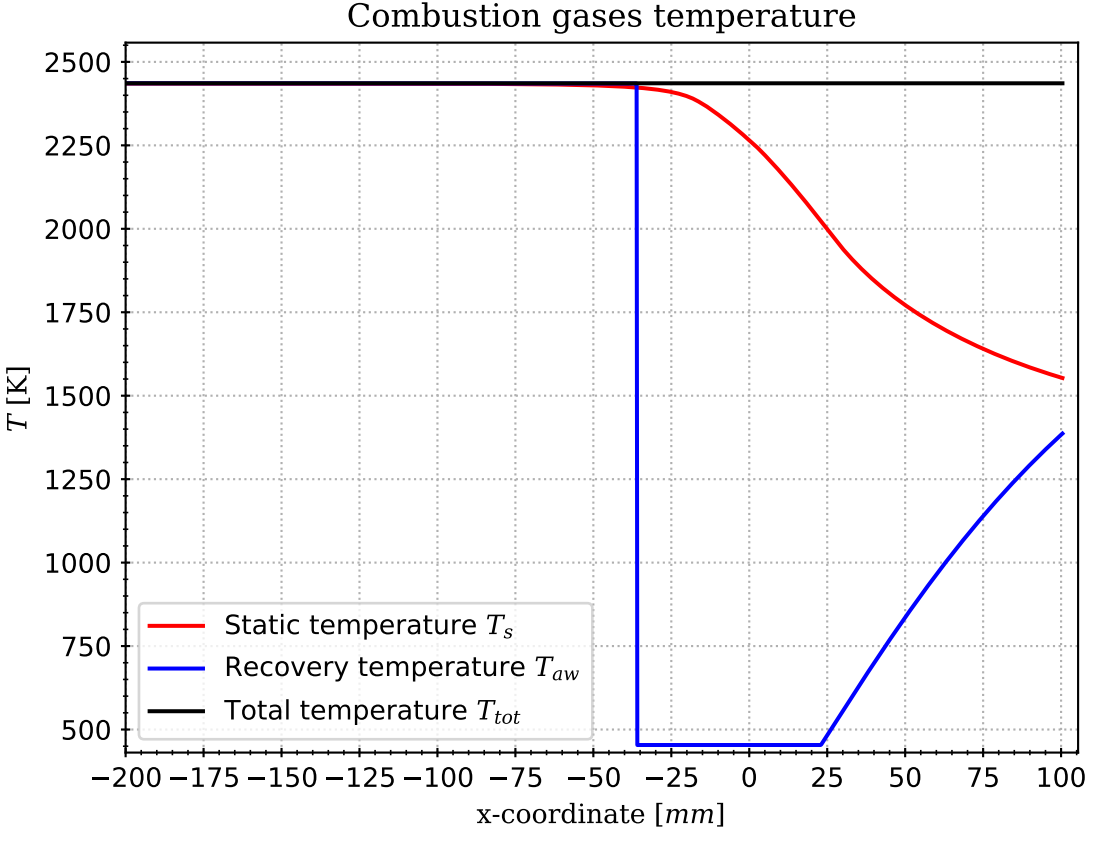

Adiabatic constant γ of the combustion gases
1.26
1.24
1.22
1.20
1.18
1.16
1.14
1.12
1.10
γ [-]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

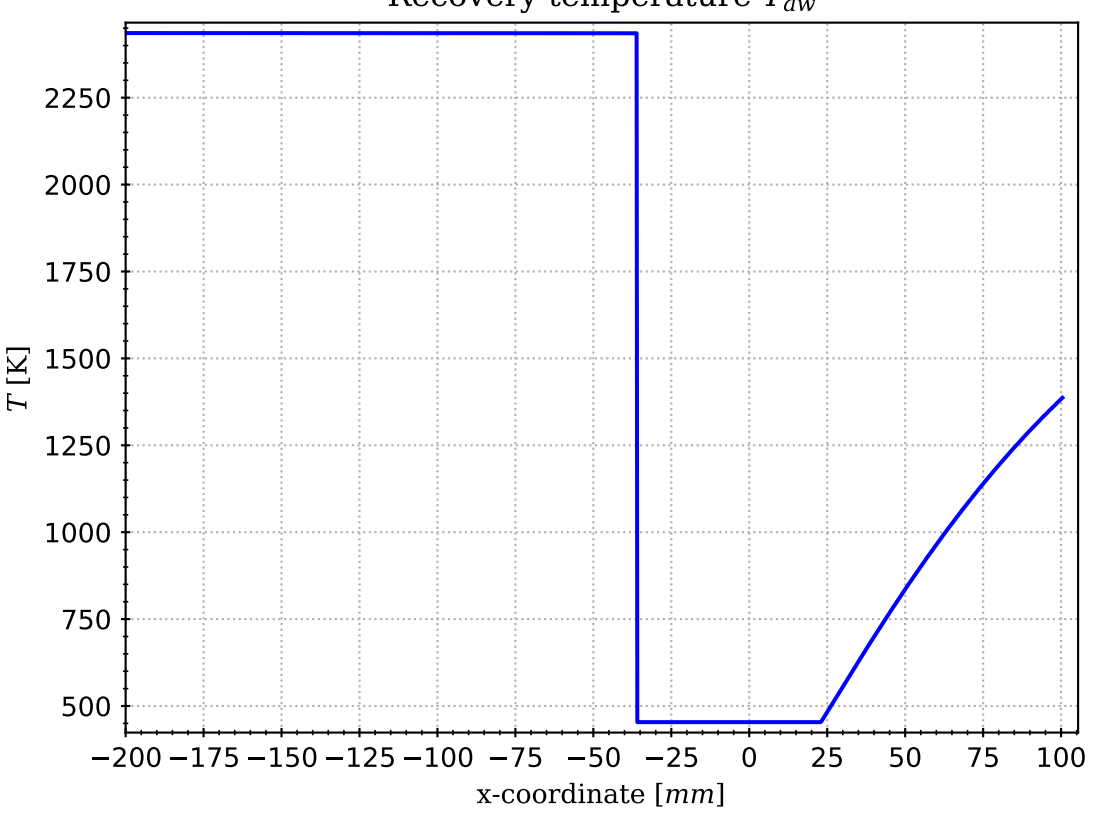

Mach number
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
Ma [-]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

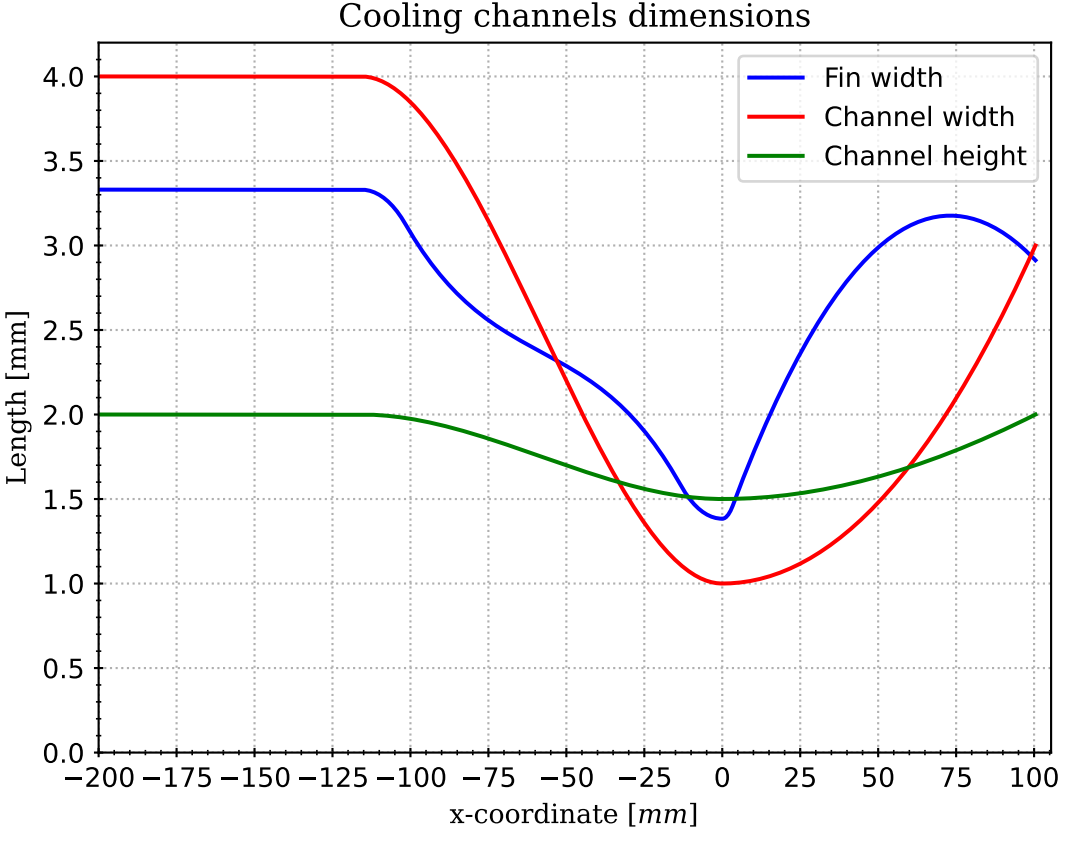

Static pressure
1e6
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
P [Pa]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

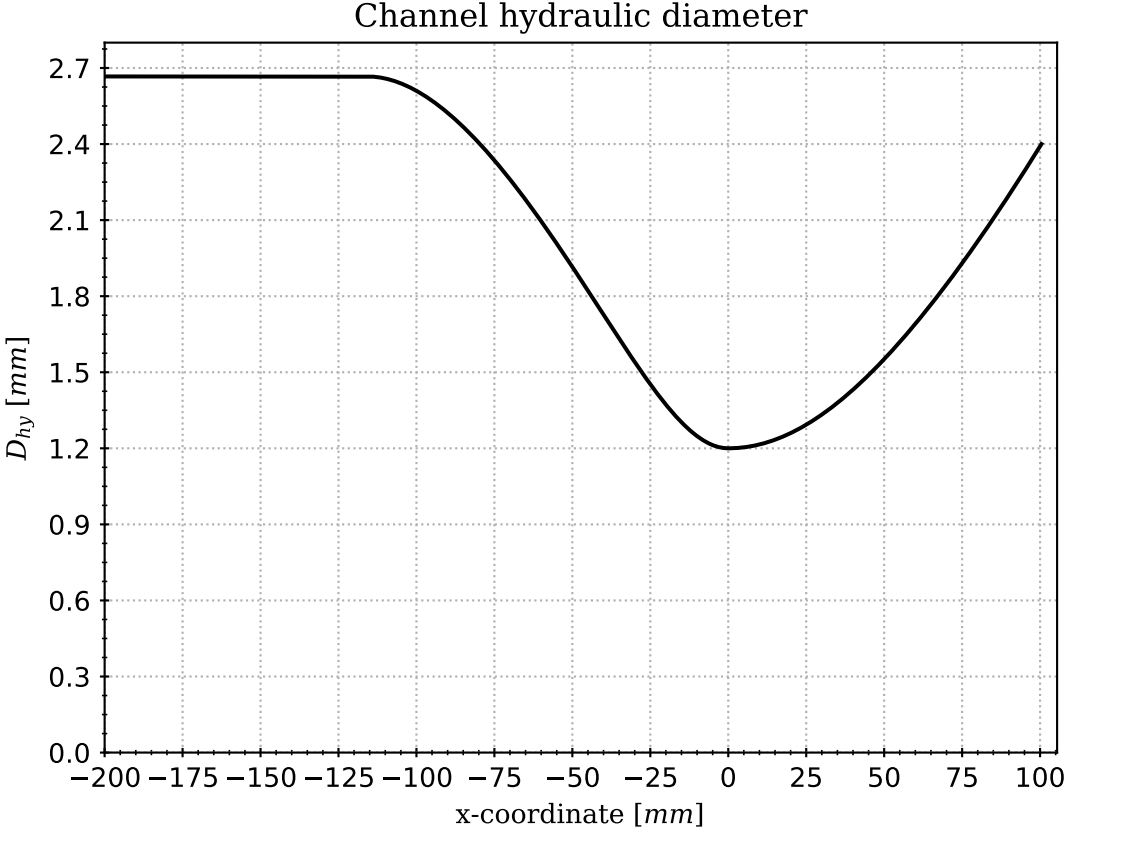

Molar fraction of combustion products
Molar fraction x_i [-]
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
−200
−175
−150
−125
−100
−75
−50
−25
0
25
50
75
100
x-coordinate [mm]
H_2O
CO_2

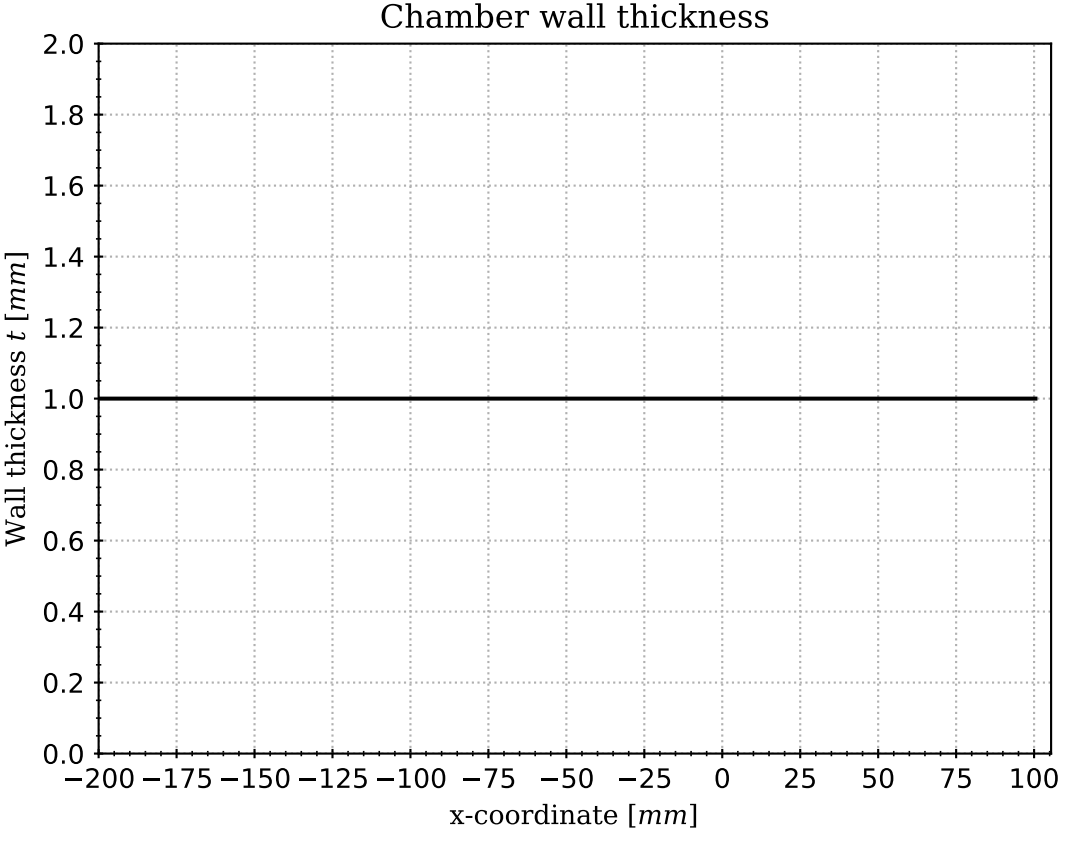

Partial pressure of combustion products
1e5
9
8
7
6
5
4
3
2
1
0
Partial pressure p_i [Pa]
H_2O
CO_2
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

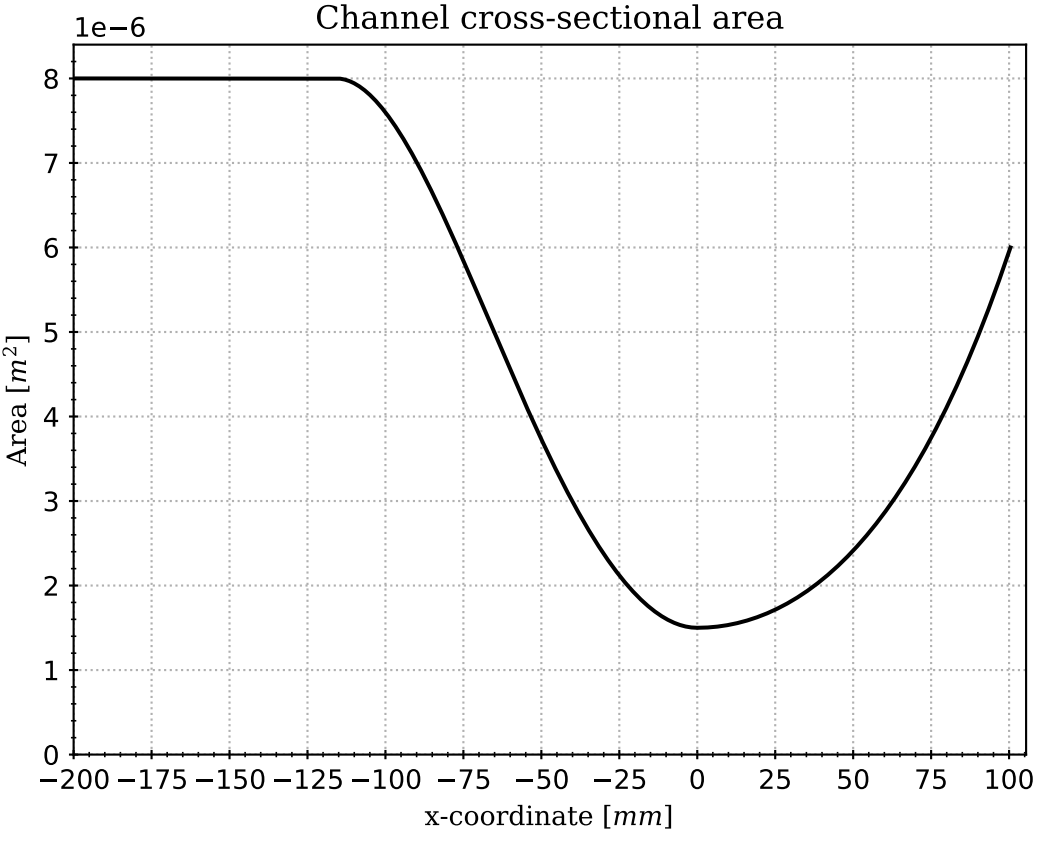

Combustion gases temperature
2500
2250
2000
1750
1500
1250
1000
750
500
T [K]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]
Static temperature T_s
Recovery temperature T_{aw}
Total temperature T_{tot}

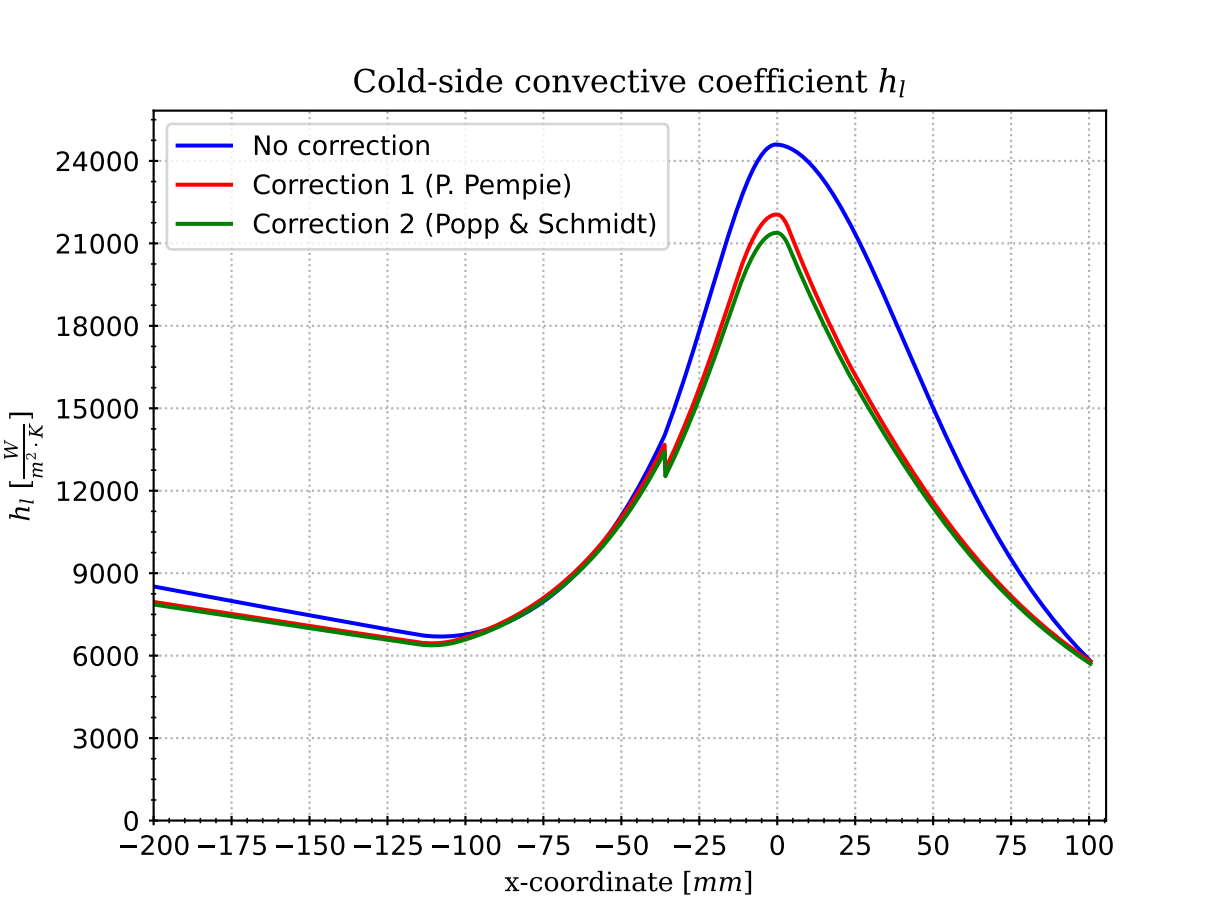

Recovery temperature T_{aw}
2250
2000
1750
1500
1250
1000
750
500
T [K]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

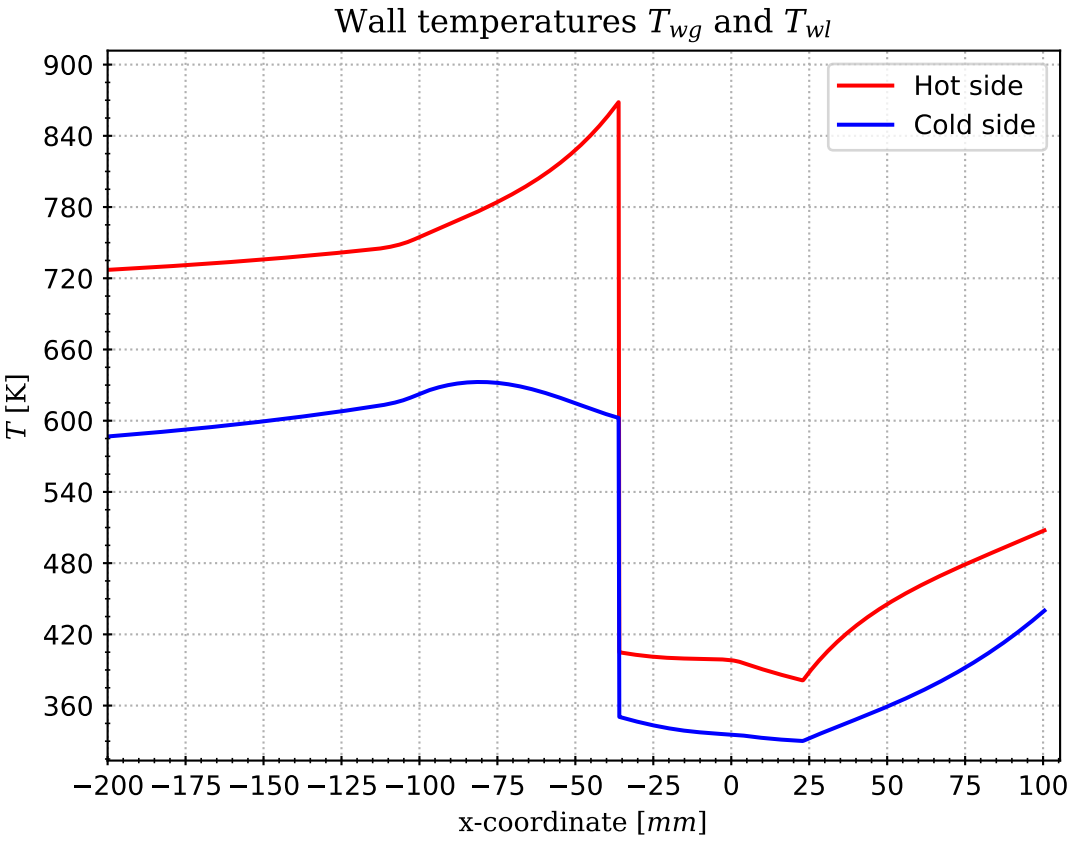

Cooling channels dimensions
Fin width
Channel width
Channel height
Length [mm]
x-coordinate [mm]
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−200
−175
−150
−125
−100
−75
−50
−25
0
25
50
75
100

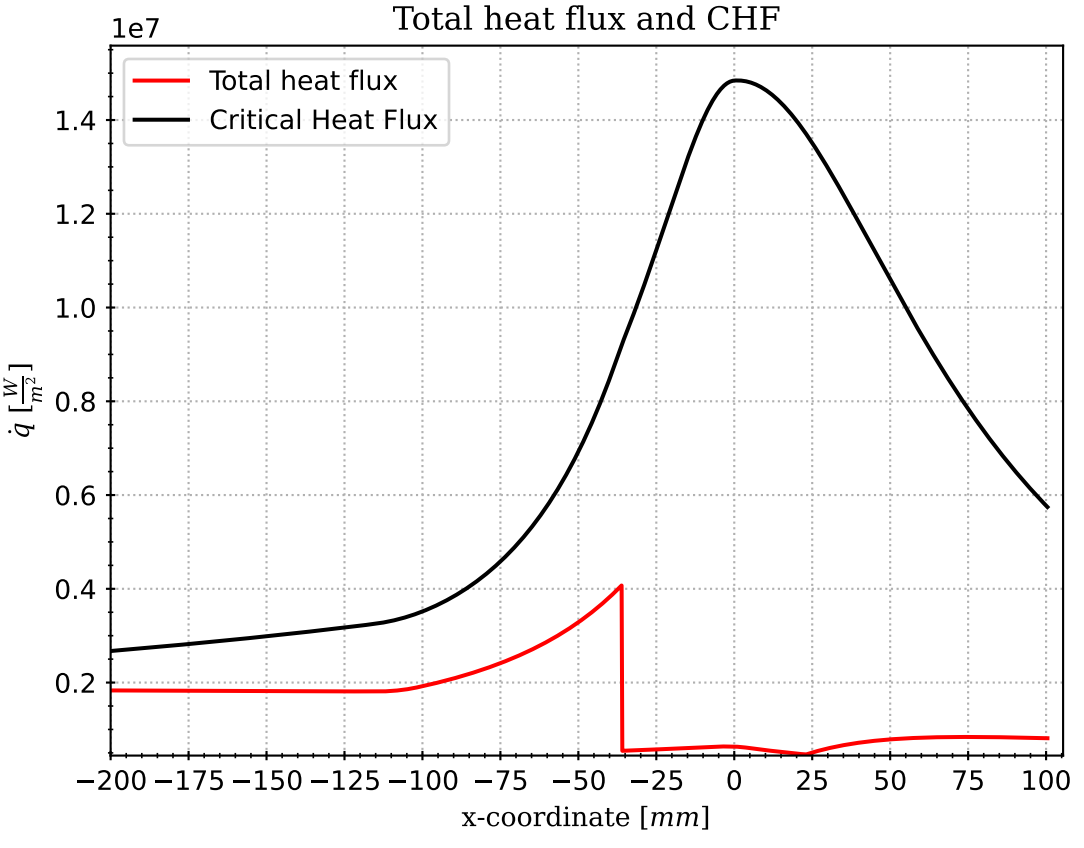

Channel hydraulic diameter
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
D_{hy} [mm]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

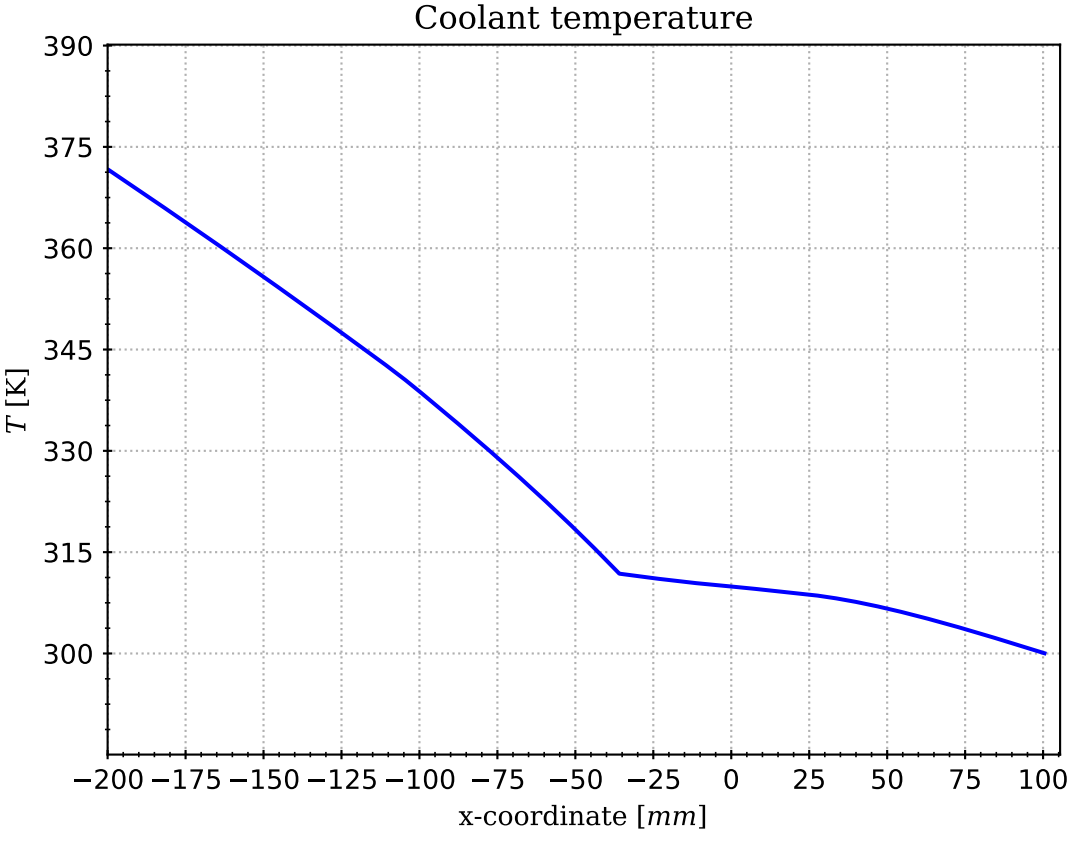

Chamber wall thickness
Wall thickness t [mm]
x-coordinate [mm]
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
−200
−175
−150
−125
−100
−75
−50
−25
0
25
50
75
100

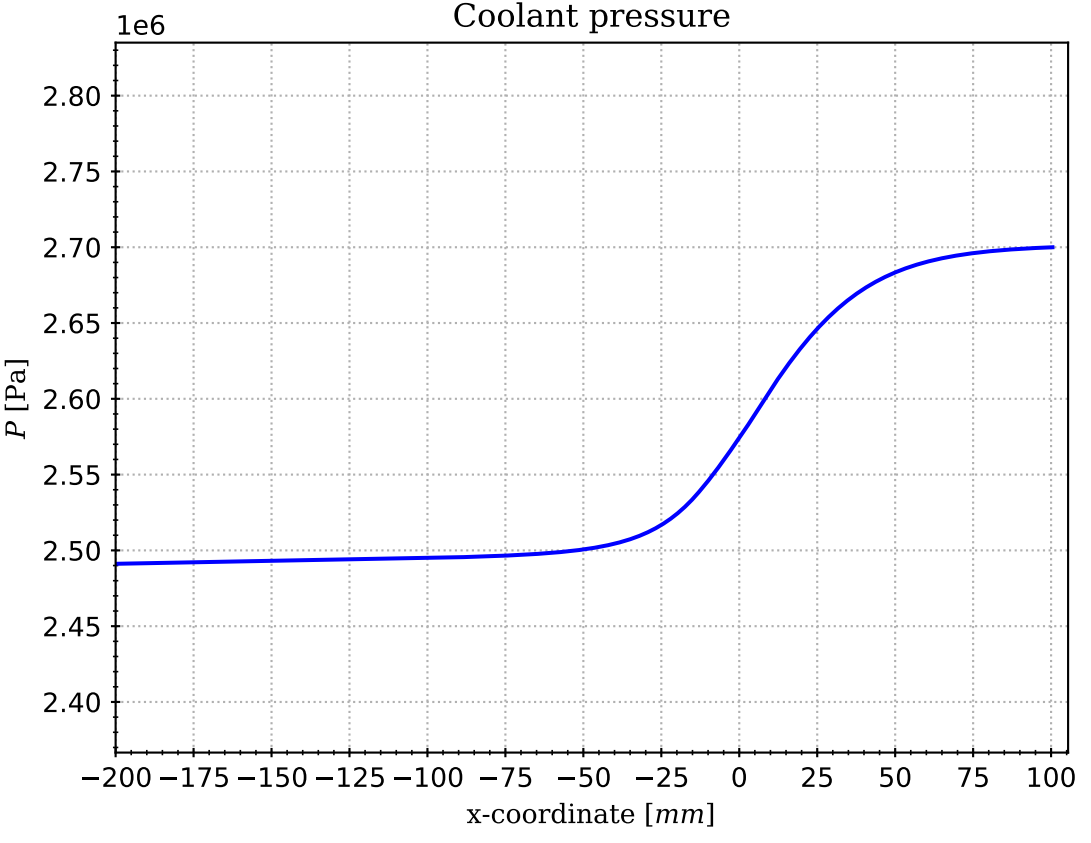

Channel cross-sectional area
1e−6
8
7
6
5
4
3
2
1
0
Area [m^2]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

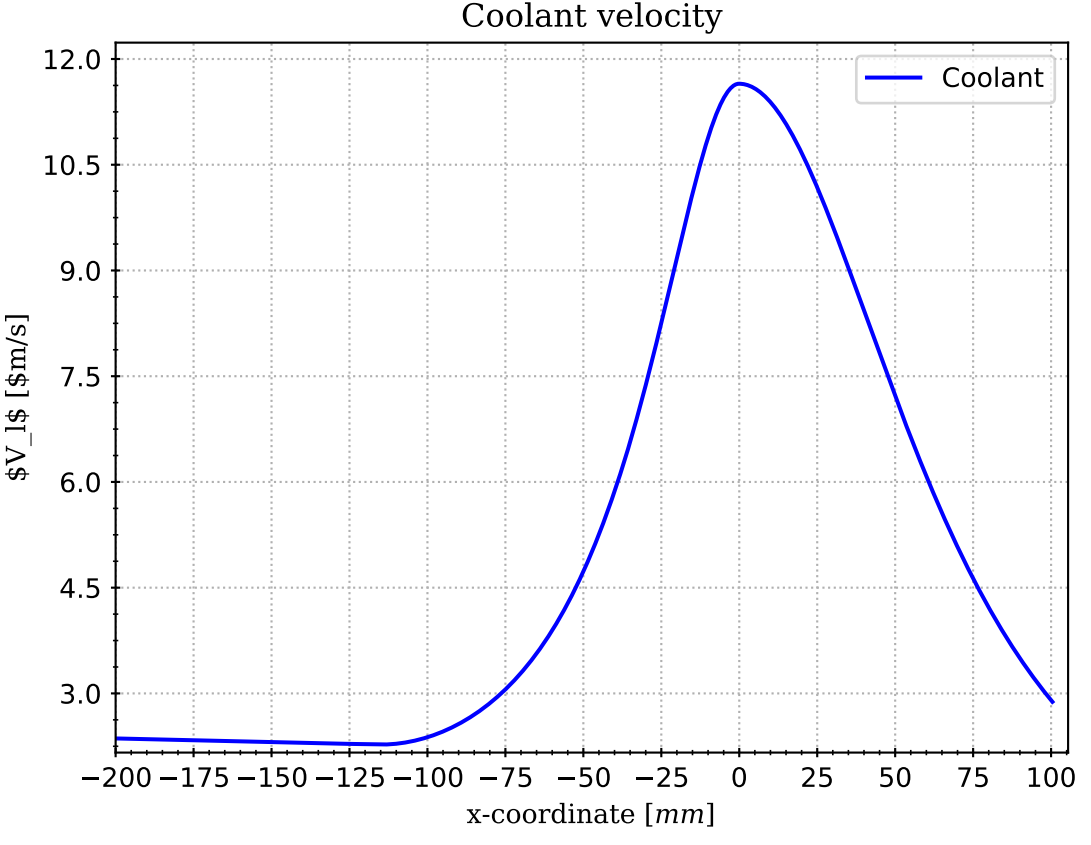

Cold-side convective coefficient h_l
No correction
Correction 1 (P. Pempie)
Correction 2 (Popp & Schmidt)
h_l [$\frac{W}{m^2 \cdot K}$]
24000
21000
18000
15000
12000
9000
6000
3000
0
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

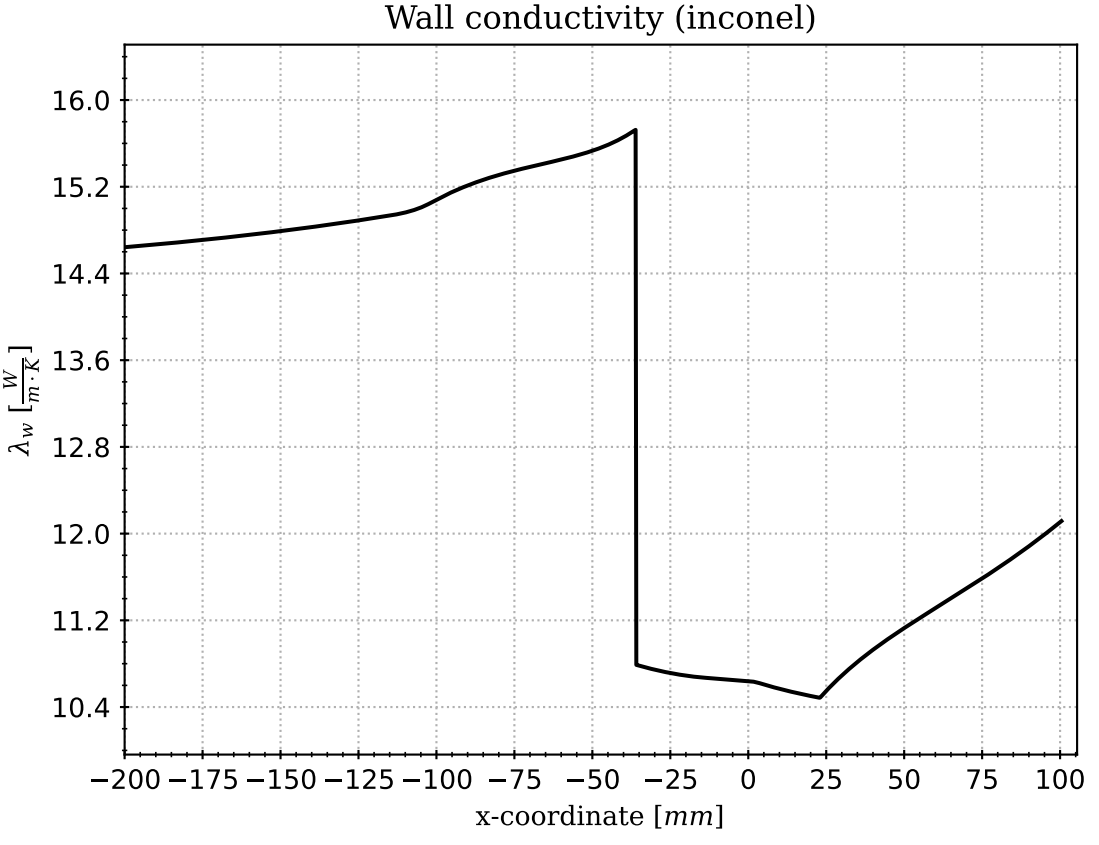

Wall temperatures T_{wg} and T_{wl}
Hot side
Cold side
900
840
780
720
660
600
540
480
420
360
T [K]
−200
−175
−150
−125
−100
−75
−50
−25
0
25
50
75
100
x-coordinate [mm]

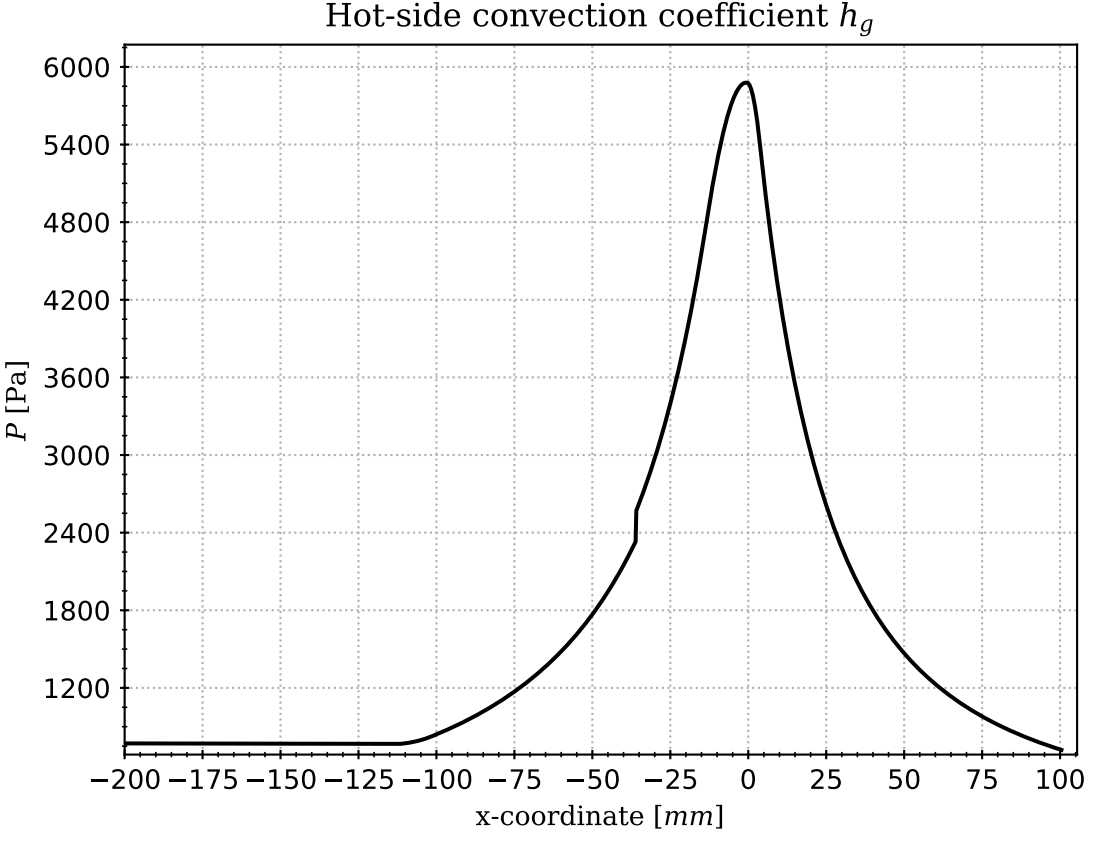

Total heat flux and CHF
1e7
Total heat flux
Critical Heat Flux
1.4
1.2
1.0
0.8
0.6
0.4
0.2
$\dot{q}\ [\frac{W}{m^2}]$
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

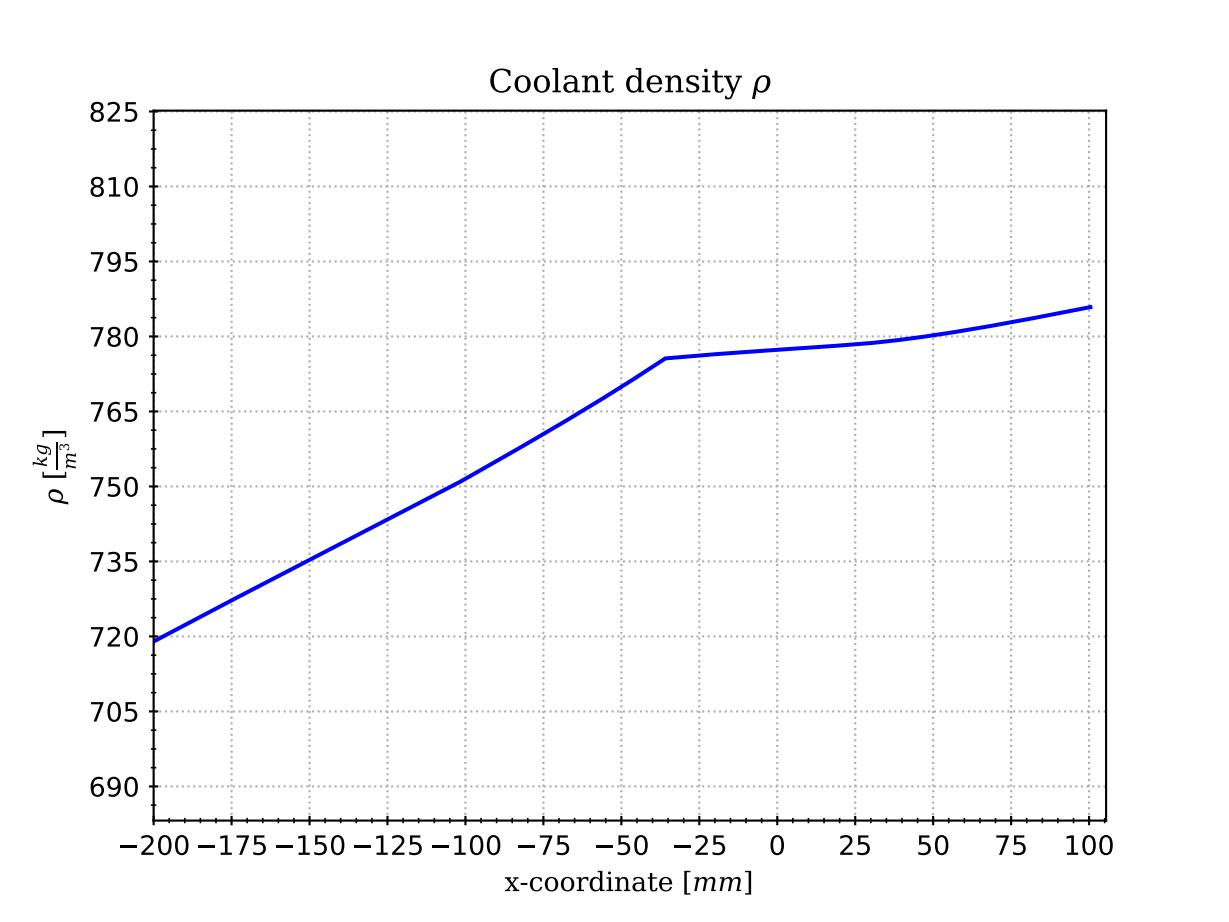

Coolant temperature
390
375
360
345
330
315
300
T [K]
−200
−175
−150
−125
−100
−75
−50
−25
0
25
50
75
100
x-coordinate [mm]

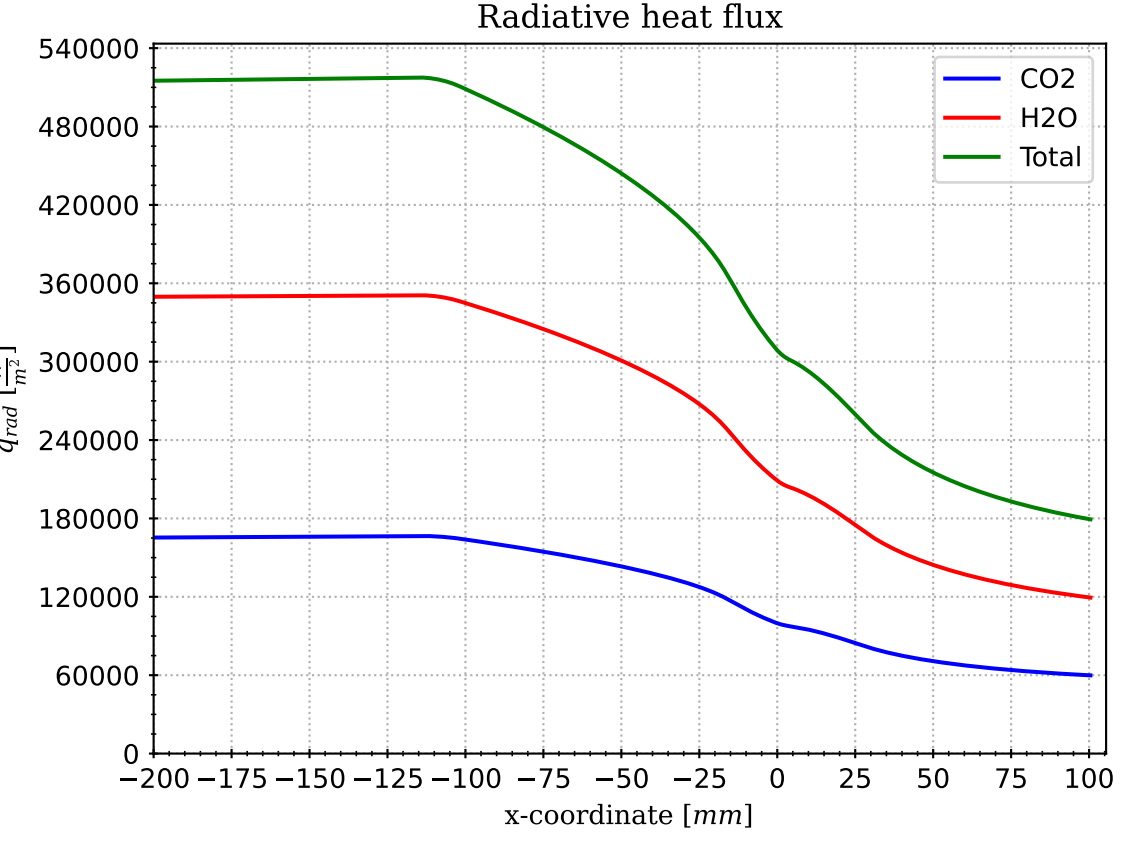

Coolant pressure
1e6
2.80
2.75
2.70
2.65
2.60
2.55
2.50
2.45
2.40
P [Pa]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

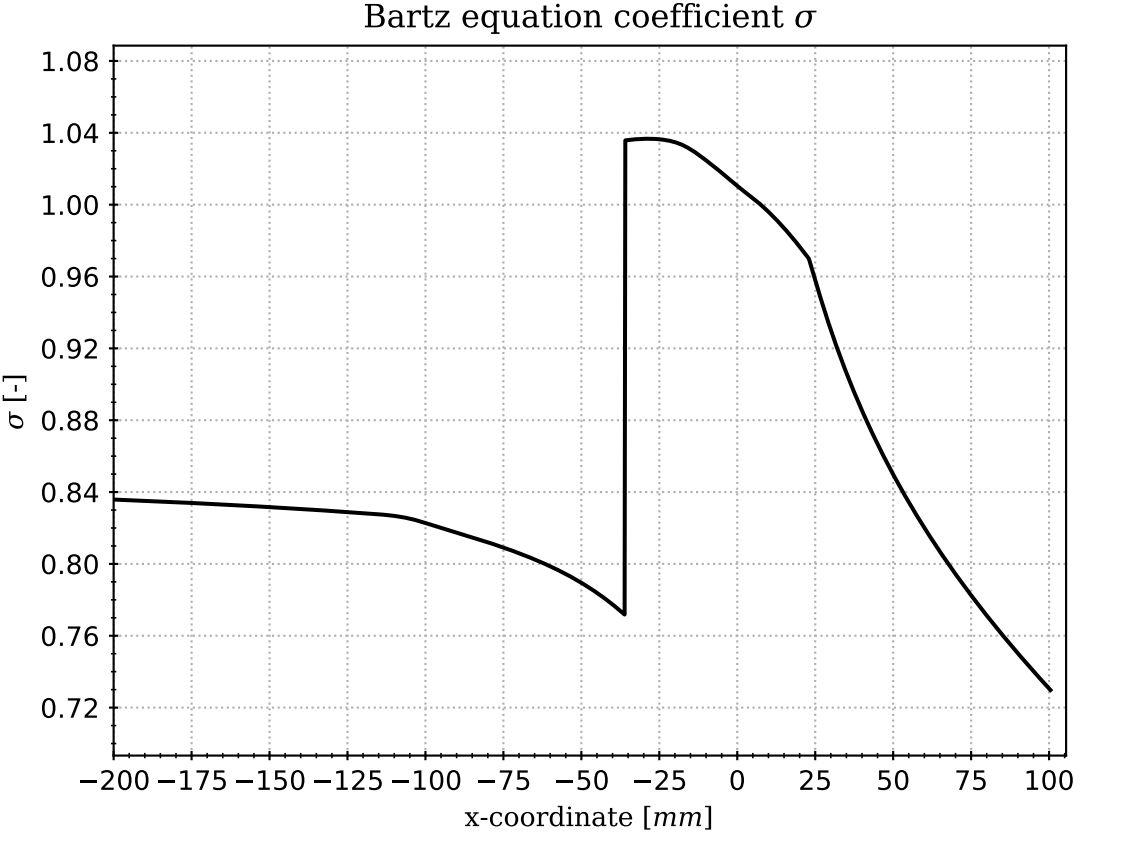

Coolant velocity
Coolant
12.0
10.5
9.0
7.5
6.0
4.5
3.0
V_l [$m/s]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

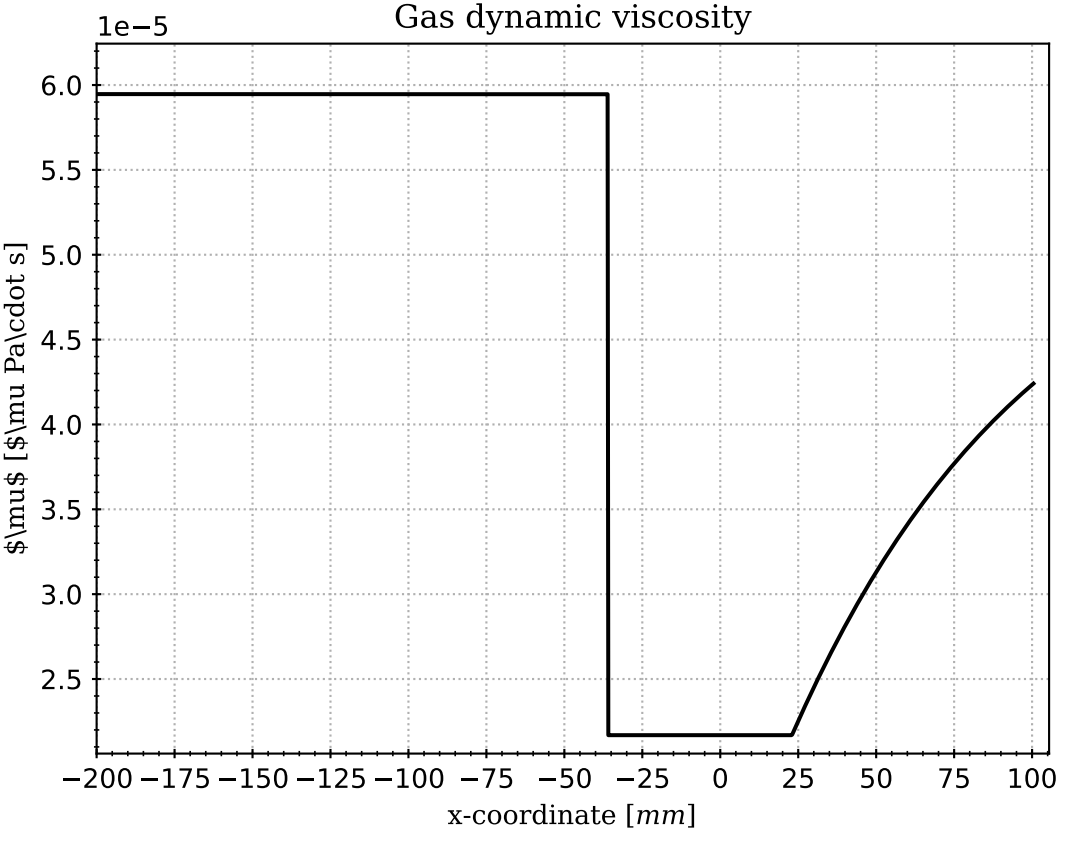

Wall conductivity (inconel)
16.0
15.2
14.4
13.6
12.8
12.0
11.2
10.4
λ_w $[\frac{W}{m \cdot K}]$
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

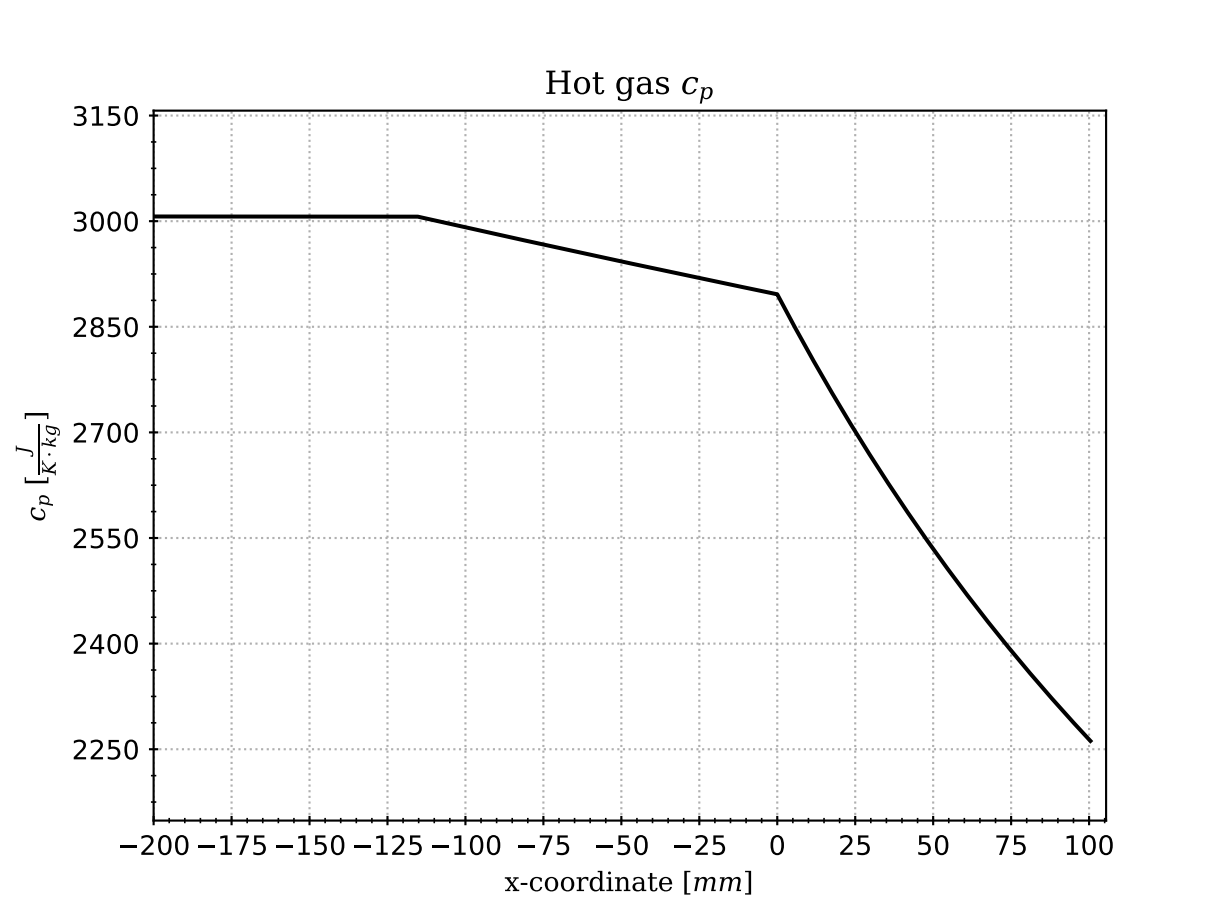

Hot-side convection coefficient h_g
6000
5400
4800
4200
3600
3000
2400
1800
1200
P [Pa]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

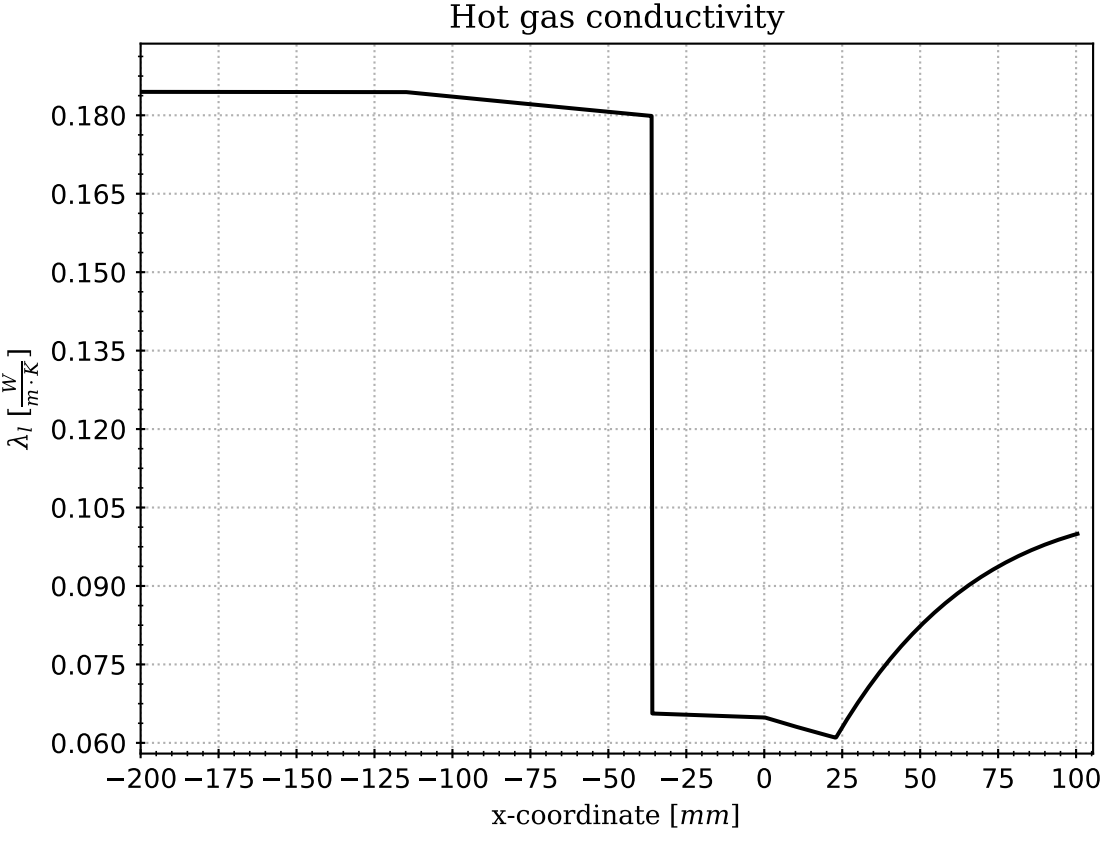

Coolant density ρ
825
810
795
780
765
750
735
720
705
690
ρ [$\frac{kg}{m^3}$]
−200
−175
−150
−125
−100
−75
−50
−25
0
25
50
75
100
x-coordinate [mm]

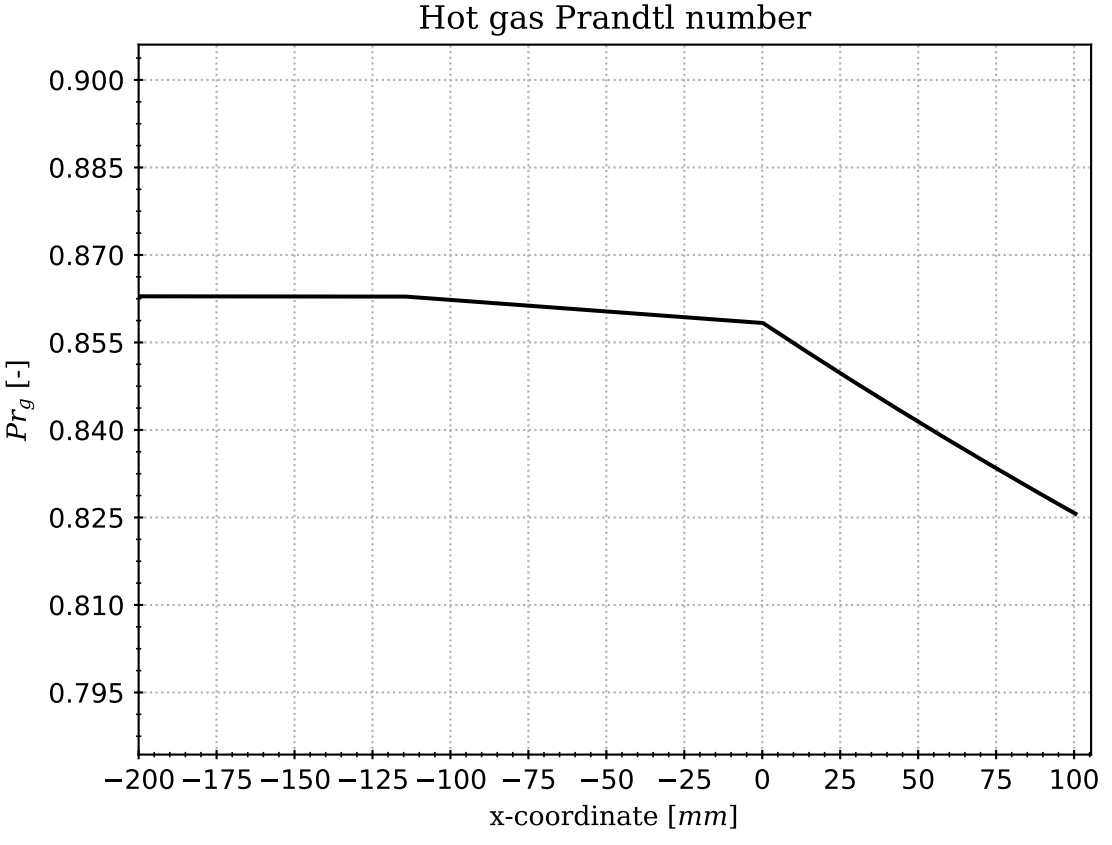

Radiative heat flux
CO2
H2O
Total
540000
480000
420000
360000
300000
240000
180000
120000
60000
0
q_{rad} $[\frac{W}{m^2}]$
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

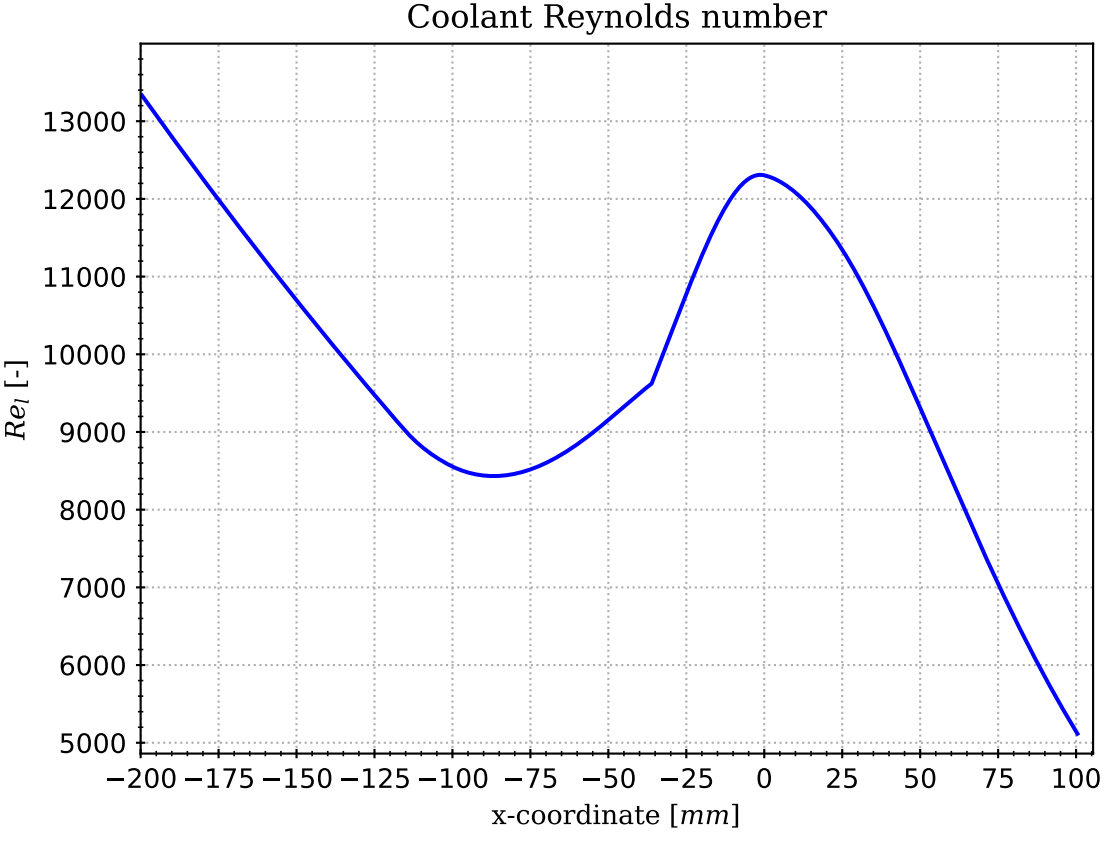

Bartz equation coefficient σ
1.08
1.04
1.00
0.96
0.92
0.88
0.84
0.80
0.76
0.72
σ [-]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

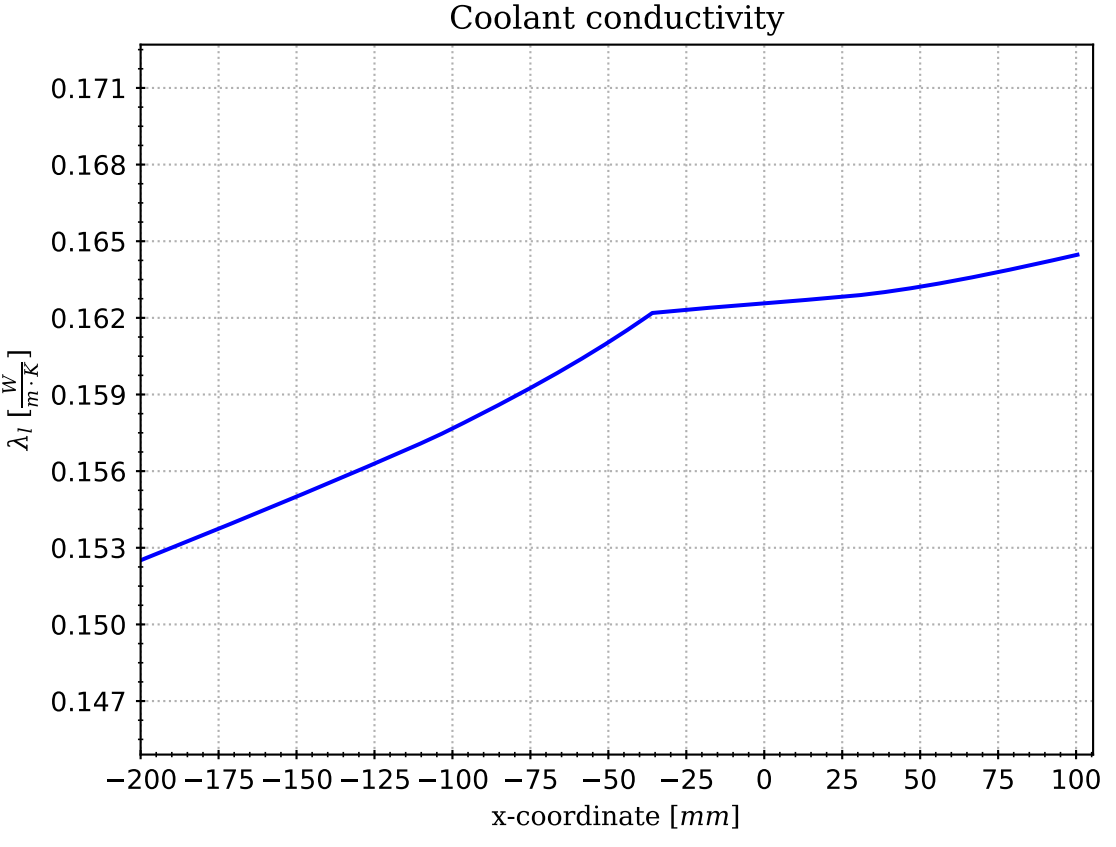

Gas dynamic viscosity
1e−5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
μ [$\mu Pa\cdot s]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

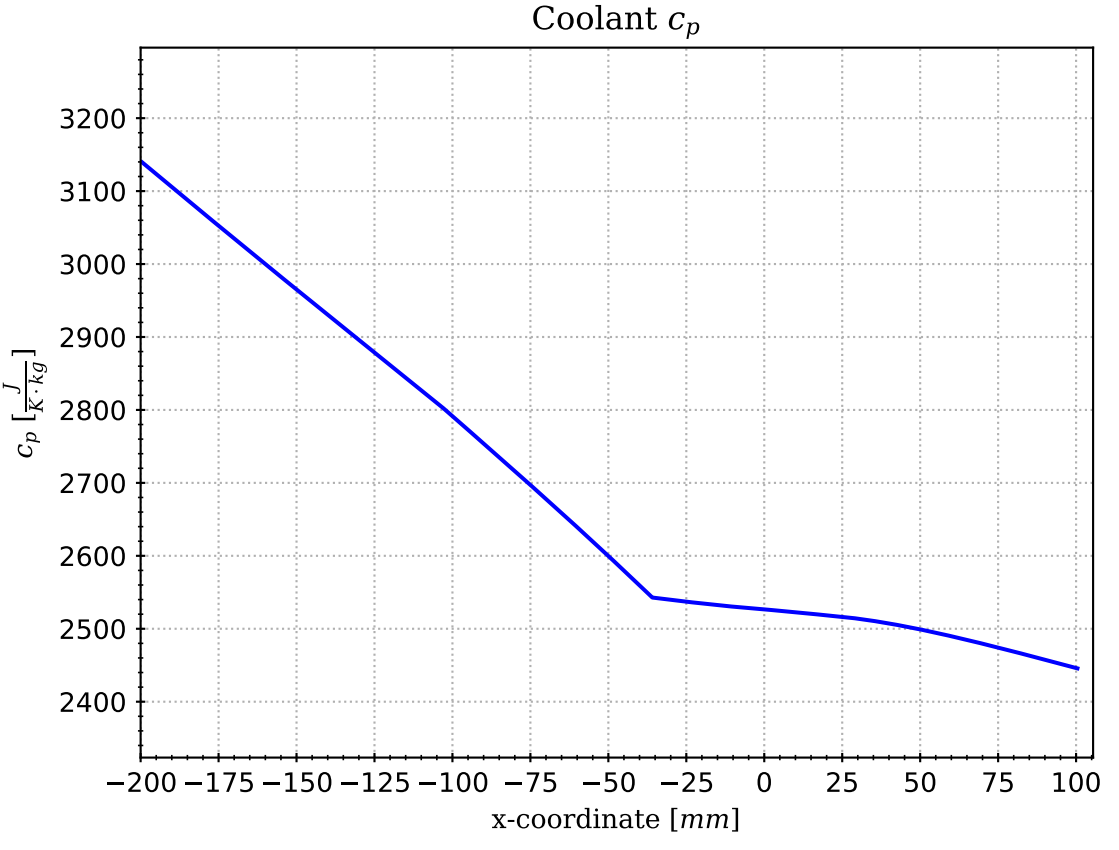

Hot gas c_p
3150
3000
2850
2700
2550
2400
2250
c_p $[\frac{J}{K \cdot kg}]$
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate $[mm]$

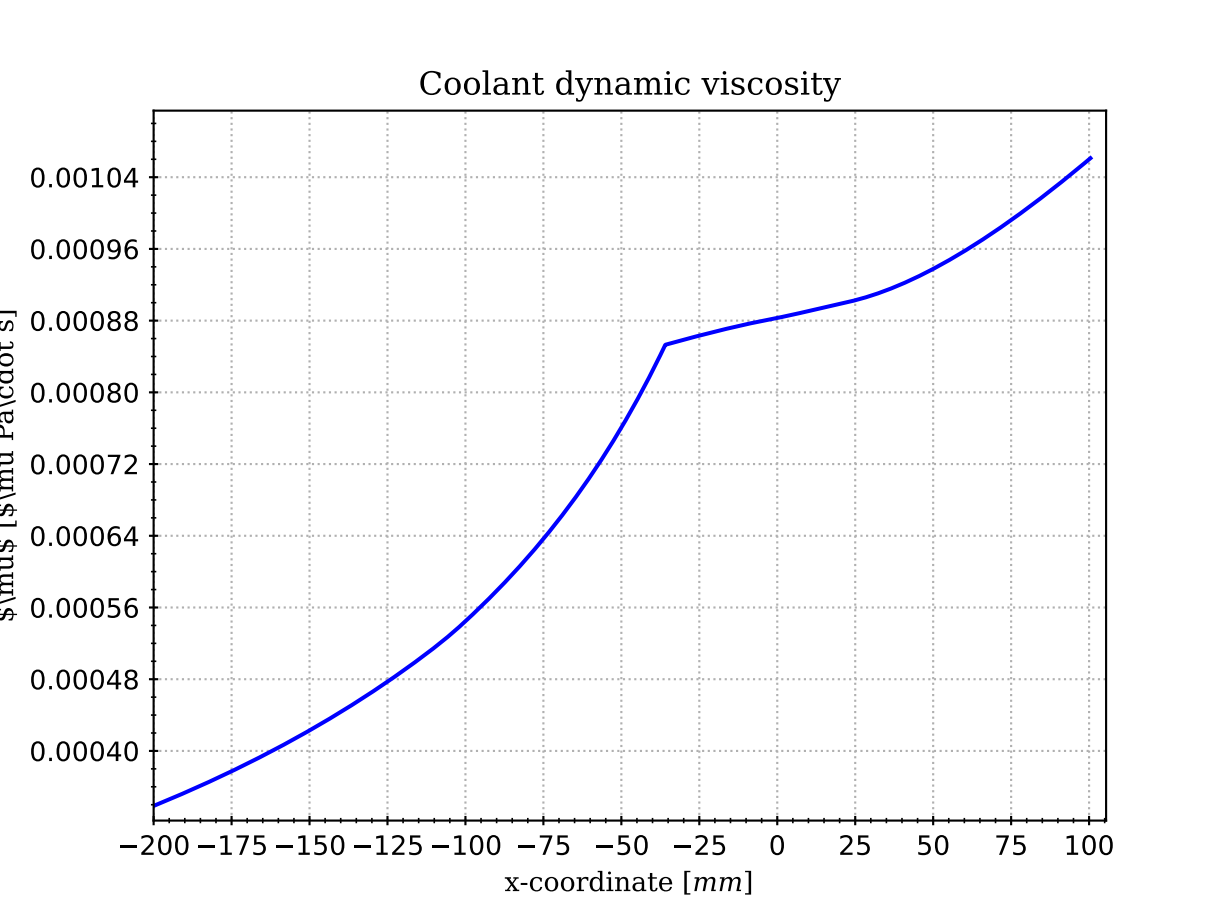

Hot gas conductivity
0.180
0.165
0.150
0.135
0.120
0.105
0.090
0.075
0.060
λ_l [$\frac{W}{m \cdot K}$]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

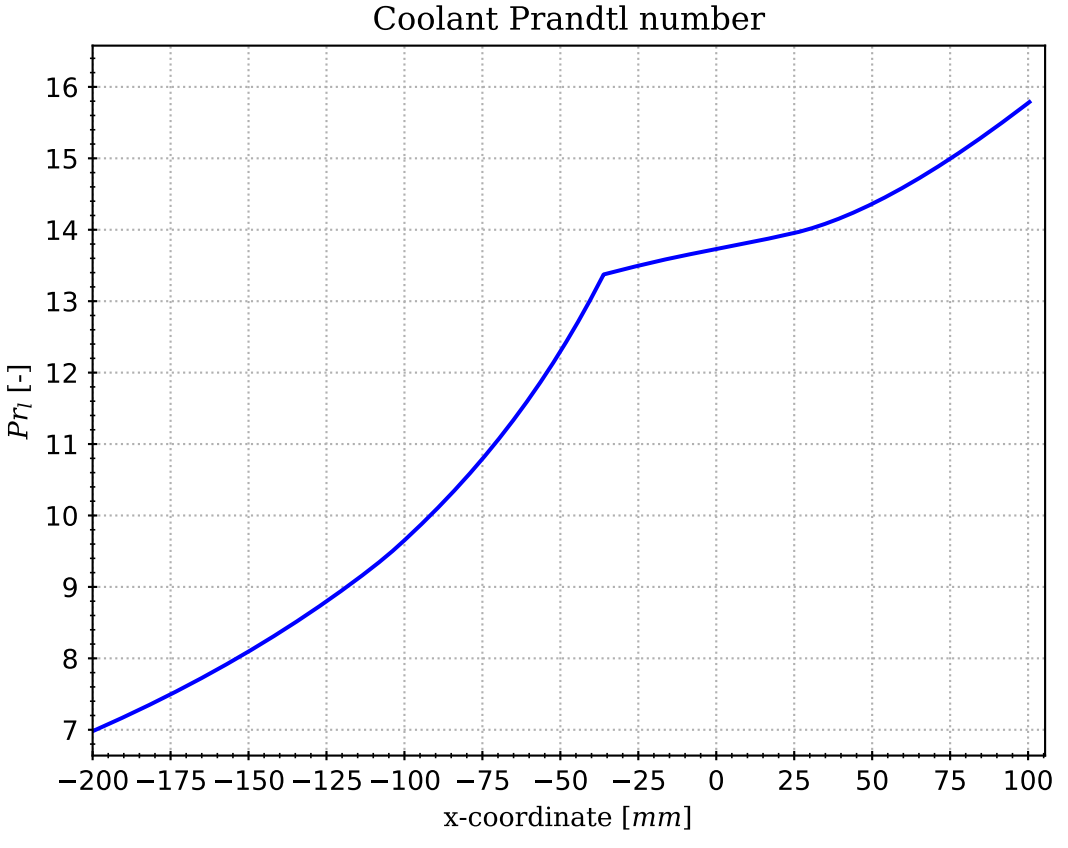

Hot gas Prandtl number
0.900
0.885
0.870
0.855
0.840
0.825
0.810
0.795
Pr_g [-]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]


Coolant Reynolds number
Re_l [-]
13000
12000
11000
10000
9000
8000
7000
6000
5000
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]


Coolant conductivity
0.171
0.168
0.165
0.162
0.159
0.156
0.153
0.150
0.147
λ_l [$\frac{W}{m \cdot K}$]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]


Coolant c_p
3200
3100
3000
2900
2800
2700
2600
2500
2400
c_p $[\frac{J}{K \cdot kg}]$
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate $[mm]$


Coolant dynamic viscosity
0.00104
0.00096
0.00088
0.00080
0.00072
0.00064
0.00056
0.00048
0.00040
μ [$\mu Pa\cdot s]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]


Coolant Prandtl number
16
15
14
13
12
11
10
9
8
7
Pr_l [-]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]