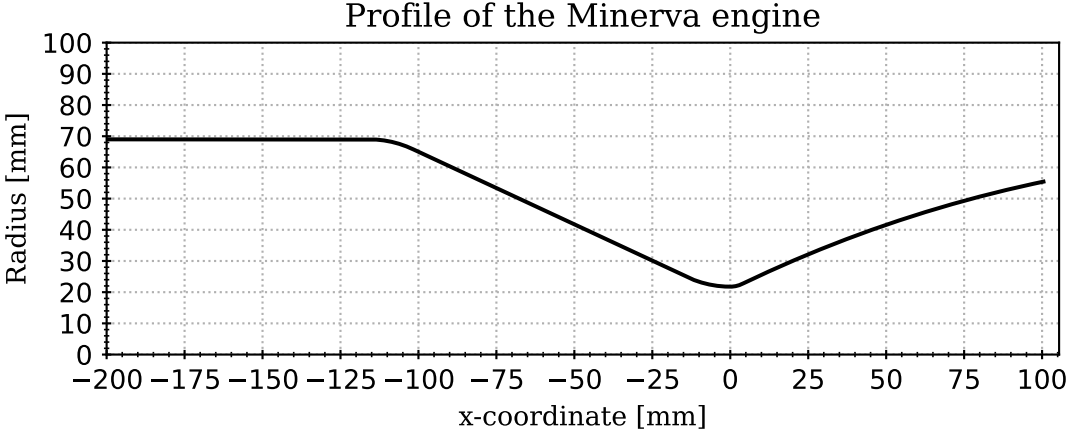
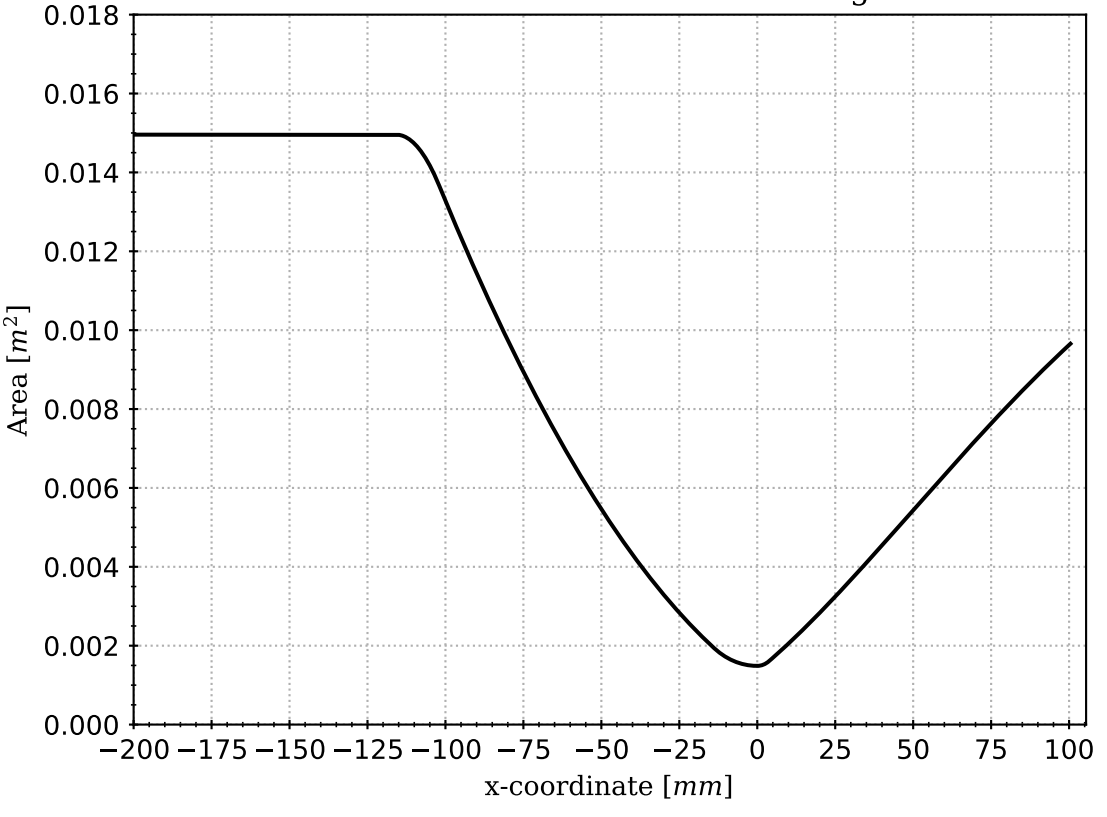
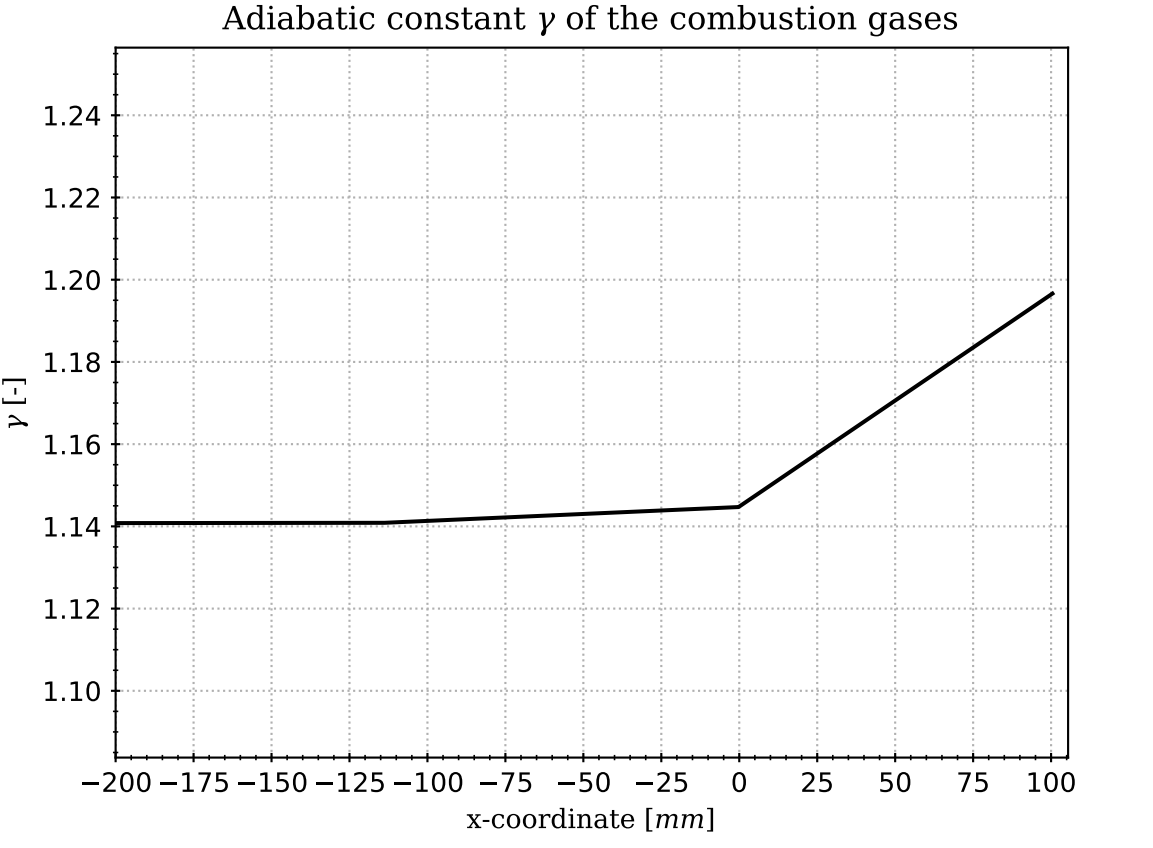
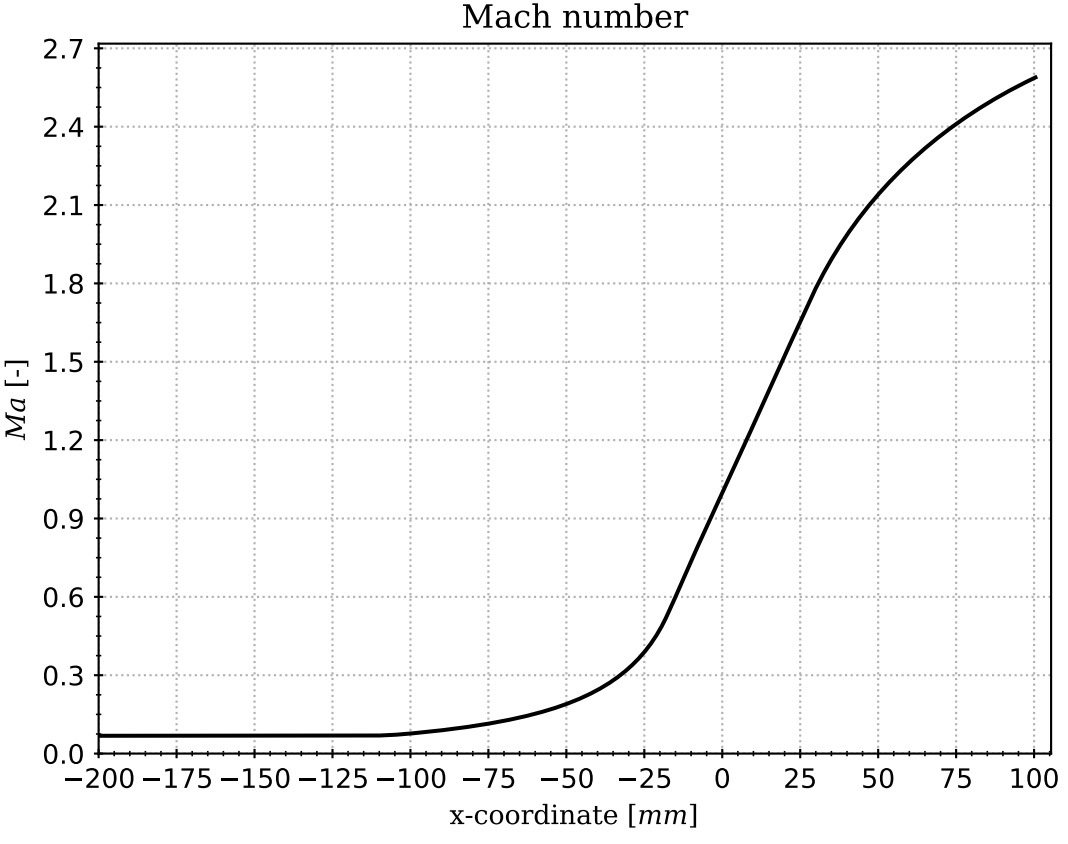
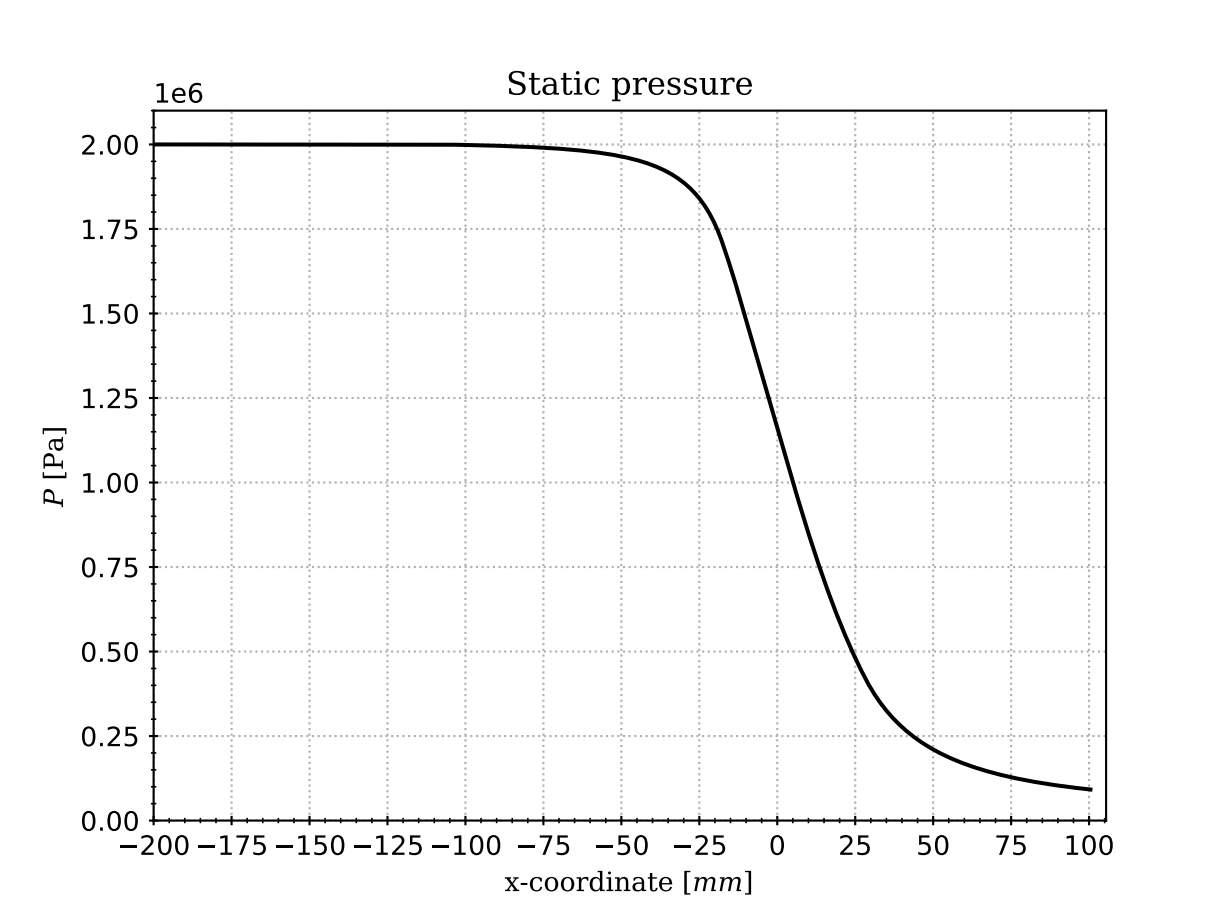
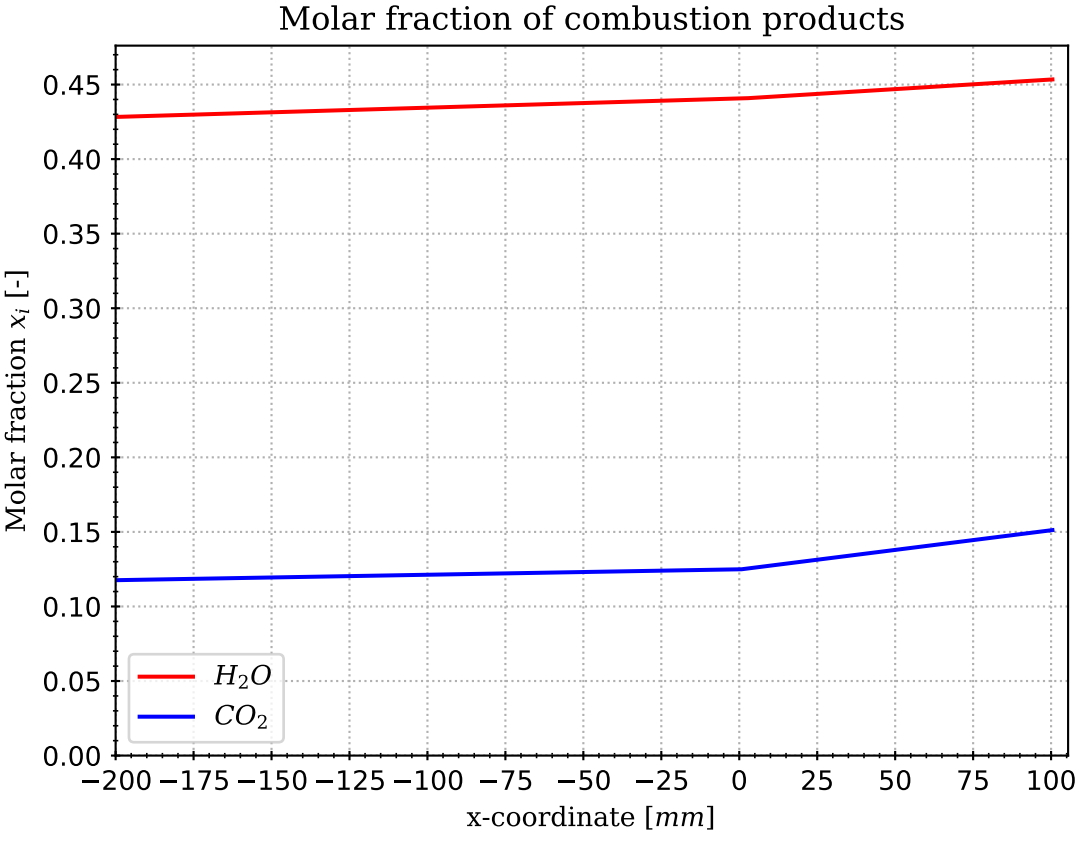

Profile of the Minerva engine
Radius [mm]
x-coordinate [mm]
100
90
80
70
60
50
40
30
20
10
0
−200
−175
−150
−125
−100
−75
−50
−25
0
25
50
75
100

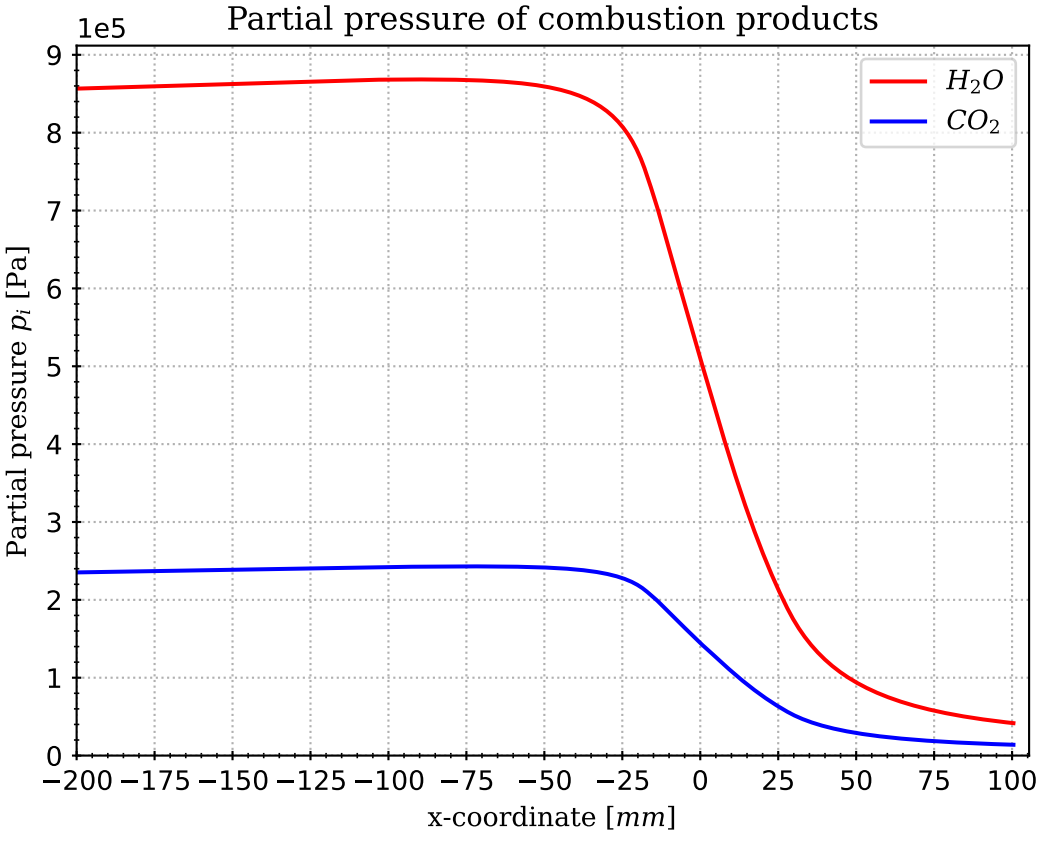

Cross-sectional area inside the engine
Area [m^2]
0.018
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

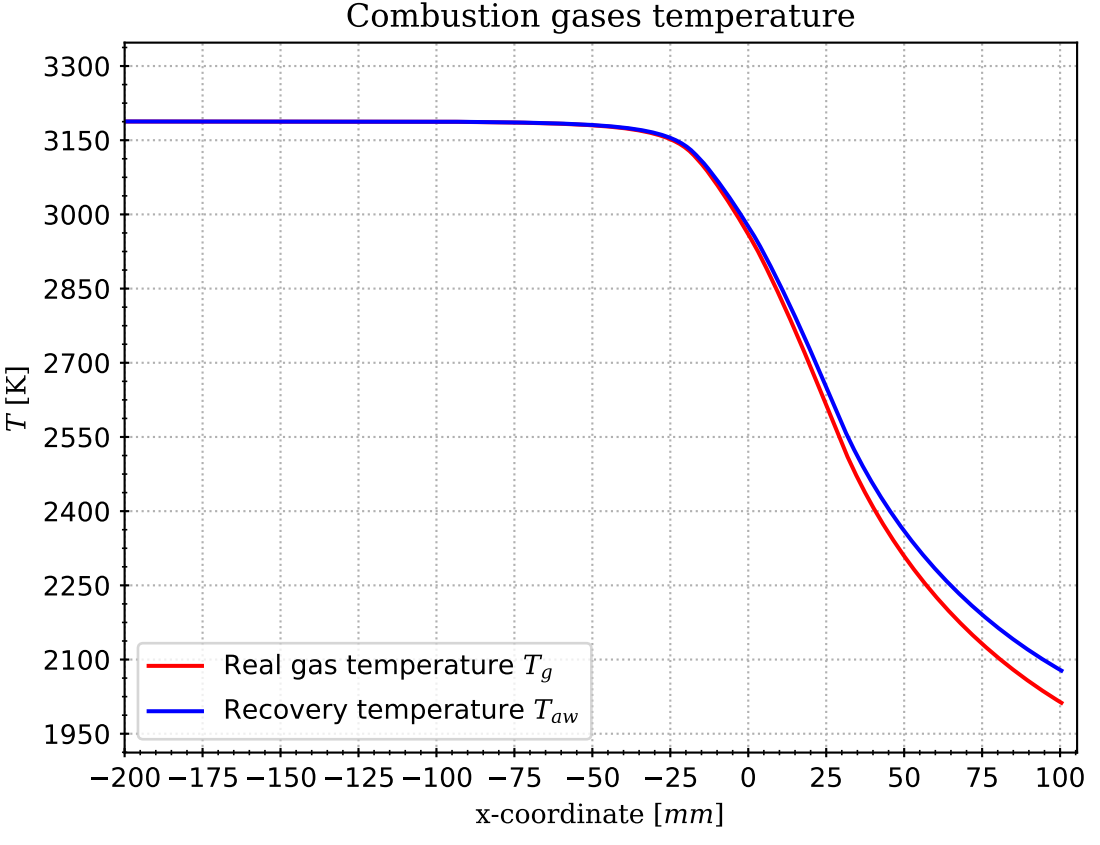

Adiabatic constant γ of the combustion gases
1.24
1.22
1.20
1.18
1.16
1.14
1.12
1.10
γ [-]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

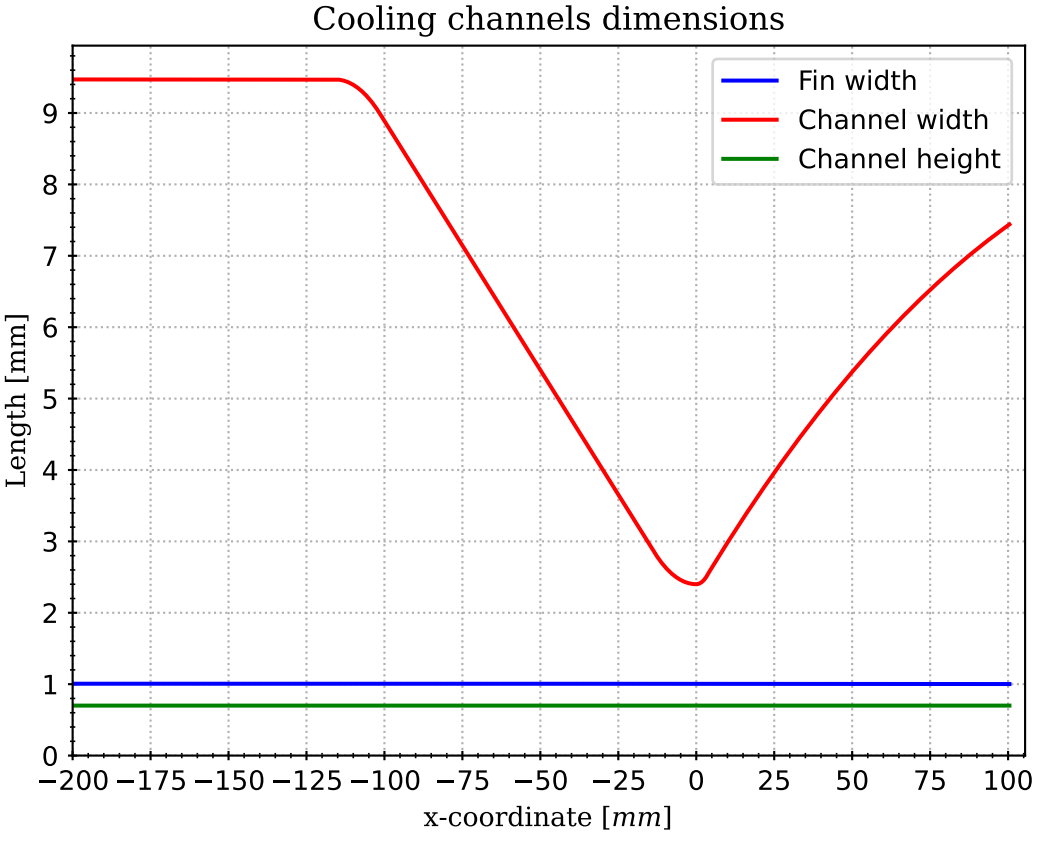

Mach number
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
Ma [-]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

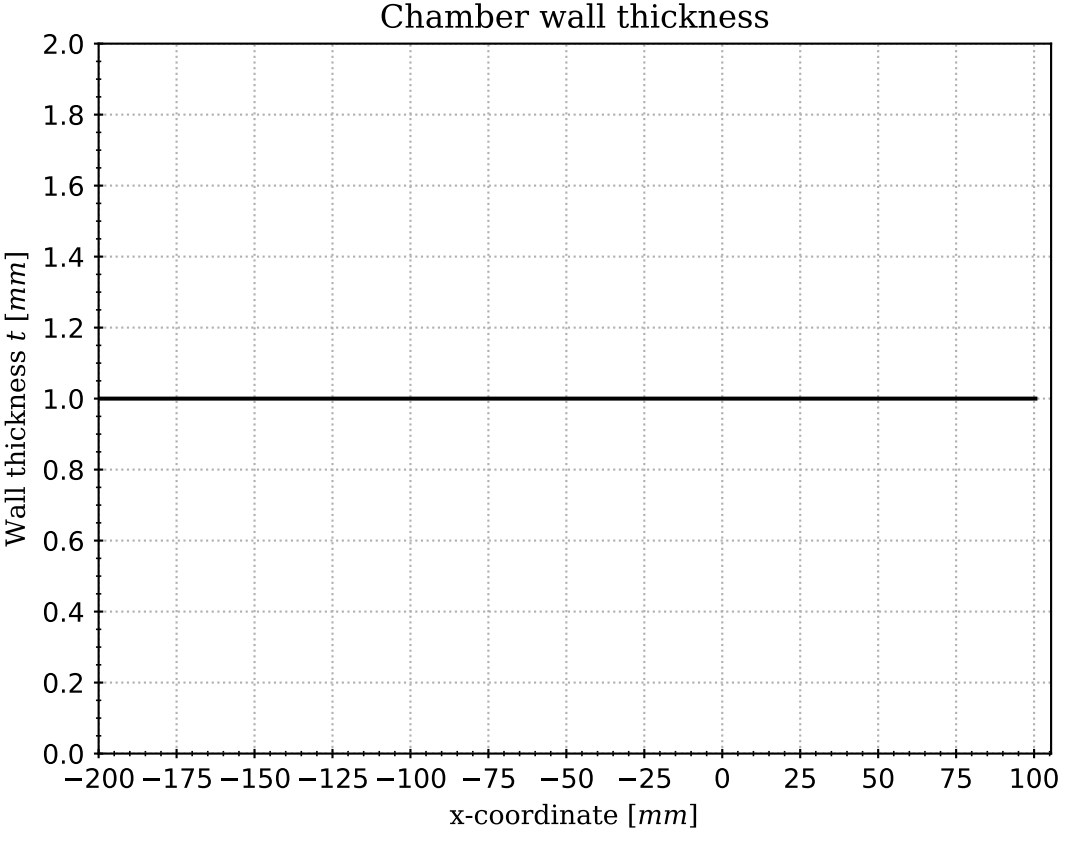

Static pressure
1e6
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
P [Pa]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

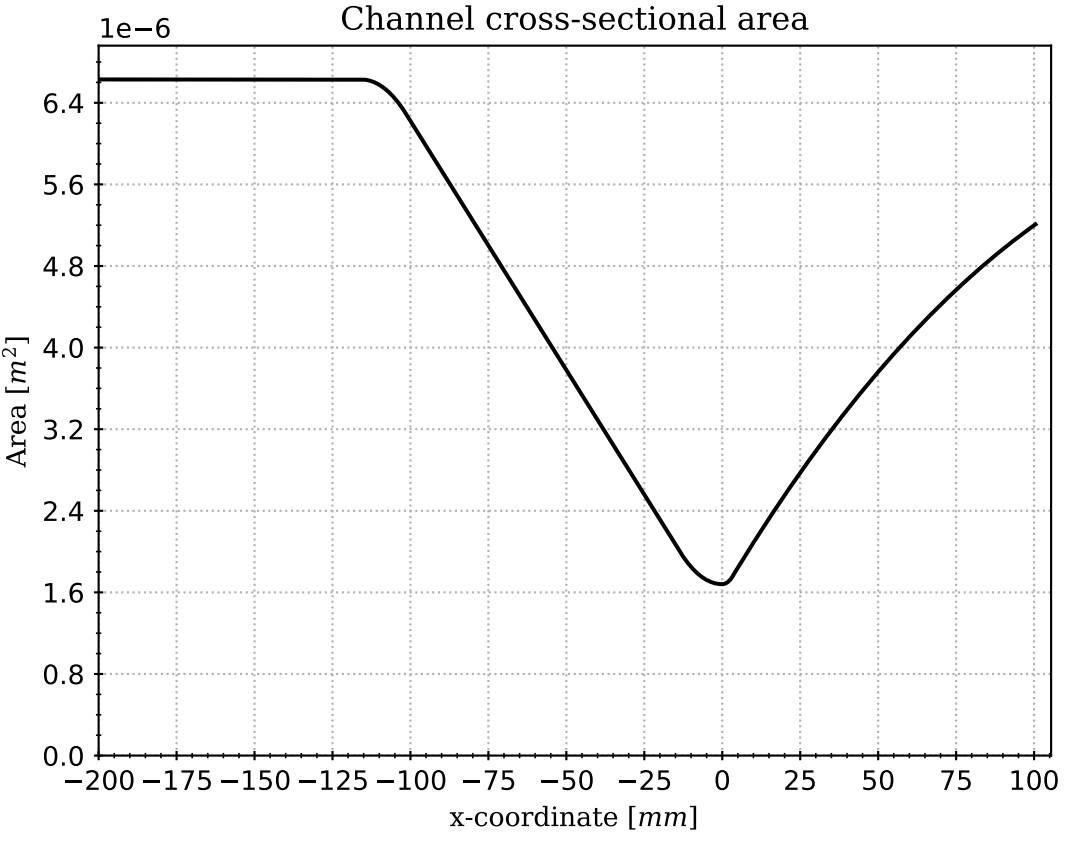

Molar fraction of combustion products
Molar fraction x_i [-]
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
−200
−175
−150
−125
−100
−75
−50
−25
0
25
50
75
100
x-coordinate [mm]
H_2O
CO_2

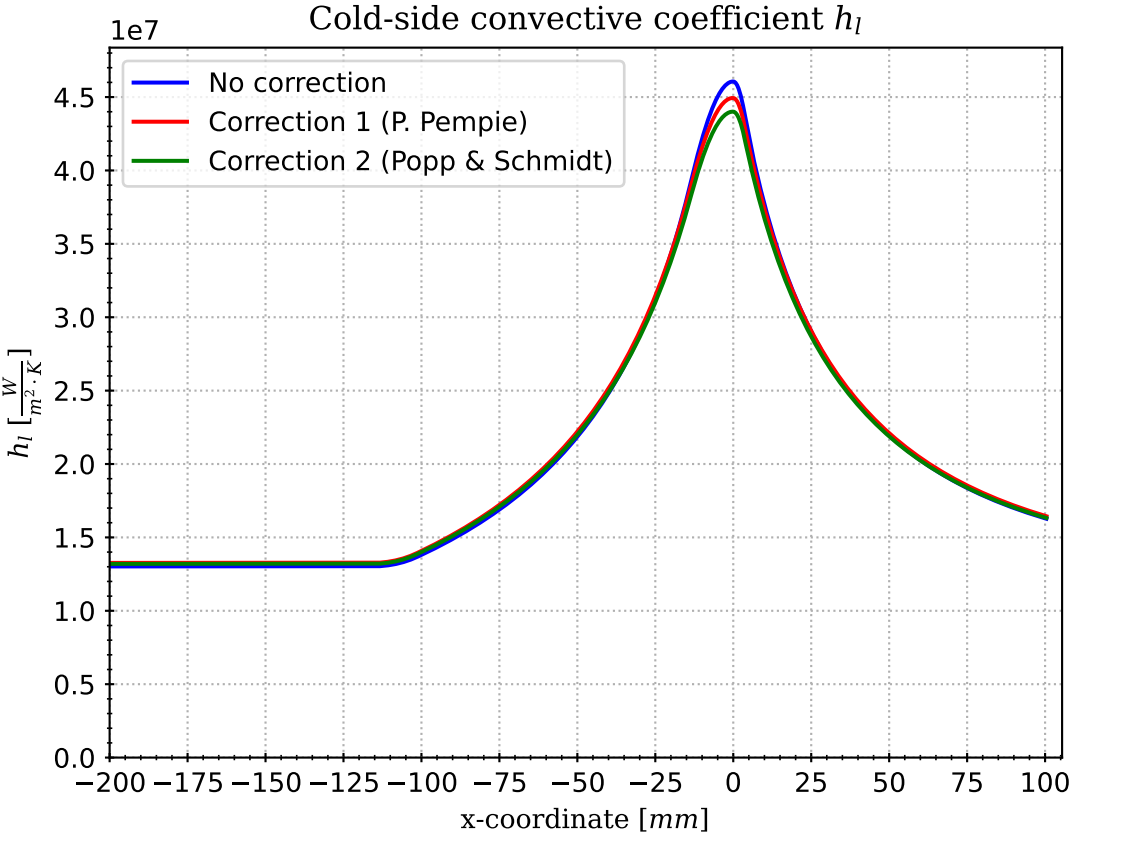

Partial pressure of combustion products
1e5
9
8
7
6
5
4
3
2
1
0
Partial pressure p_i [Pa]
H_2O
CO_2
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

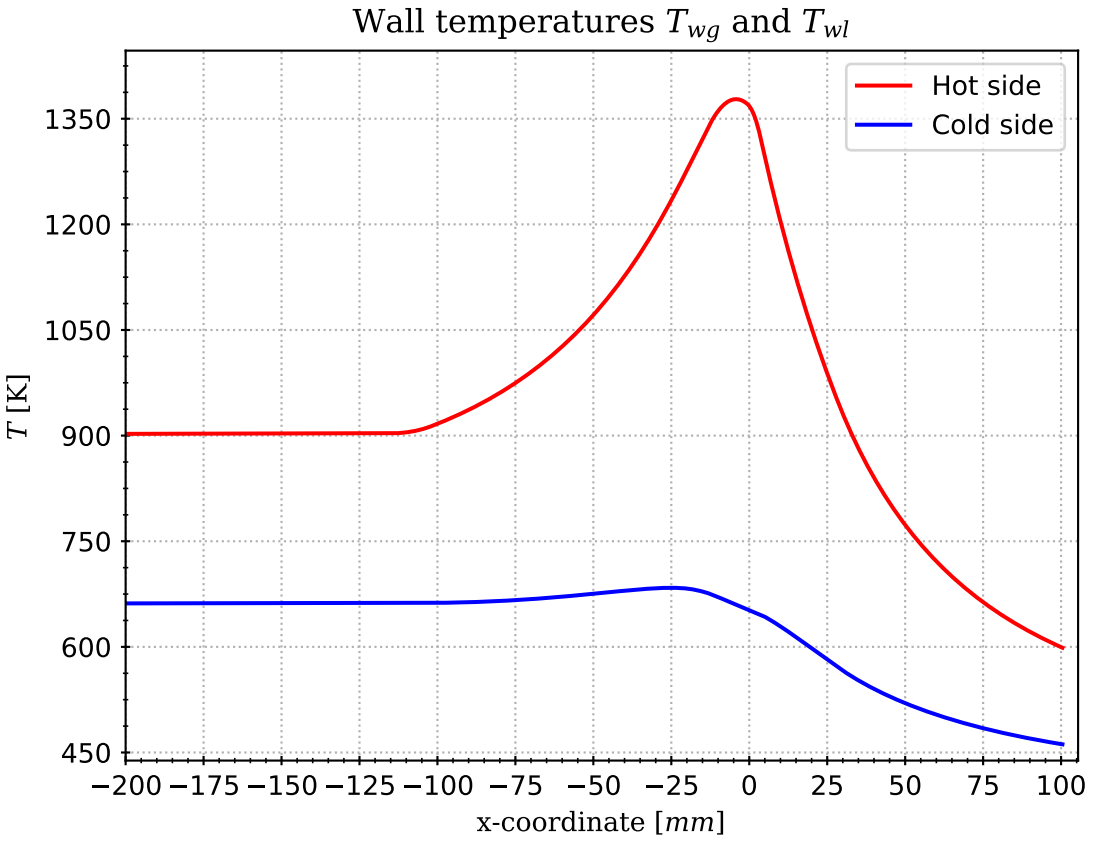

Combustion gases temperature
3300
3150
3000
2850
2700
2550
2400
2250
2100
1950
T [K]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]
Real gas temperature T_g
Recovery temperature T_{aw}

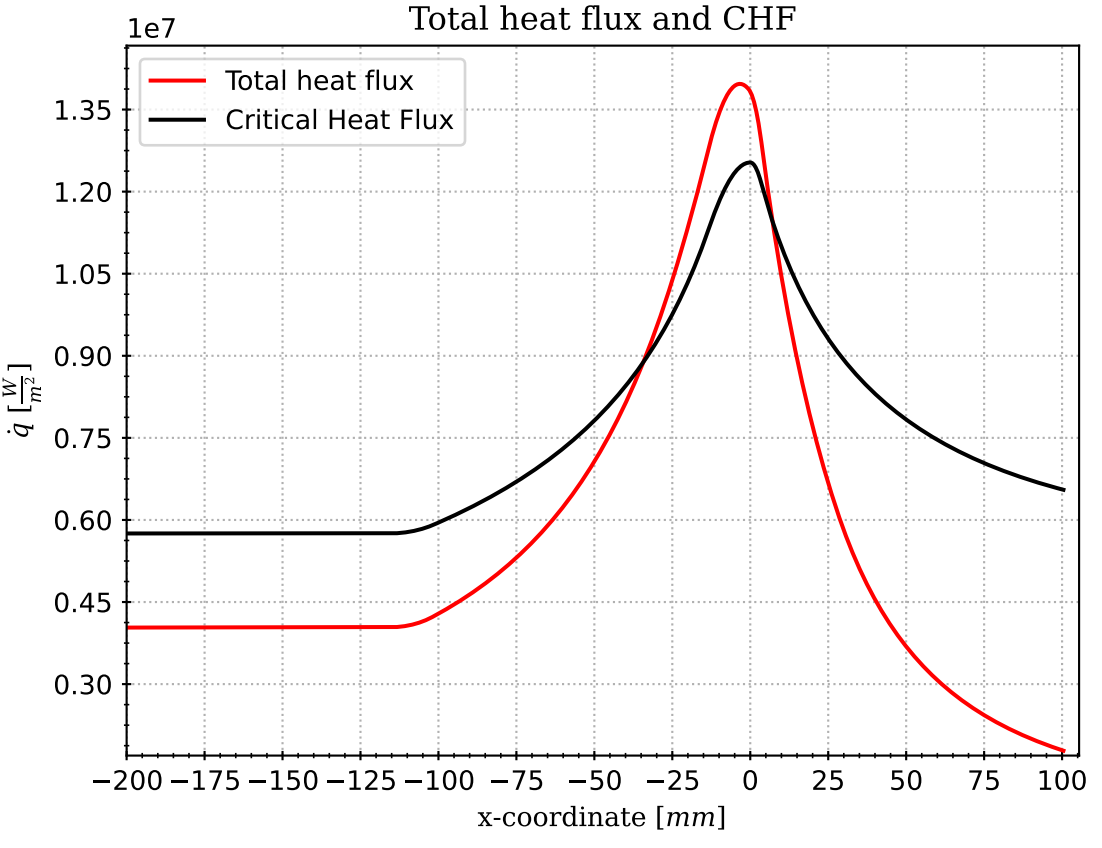

Cooling channels dimensions
Fin width
Channel width
Channel height
Length [mm]
x-coordinate [mm]
0
1
2
3
4
5
6
7
8
9
−200
−175
−150
−125
−100
−75
−50
−25
0
25
50
75
100

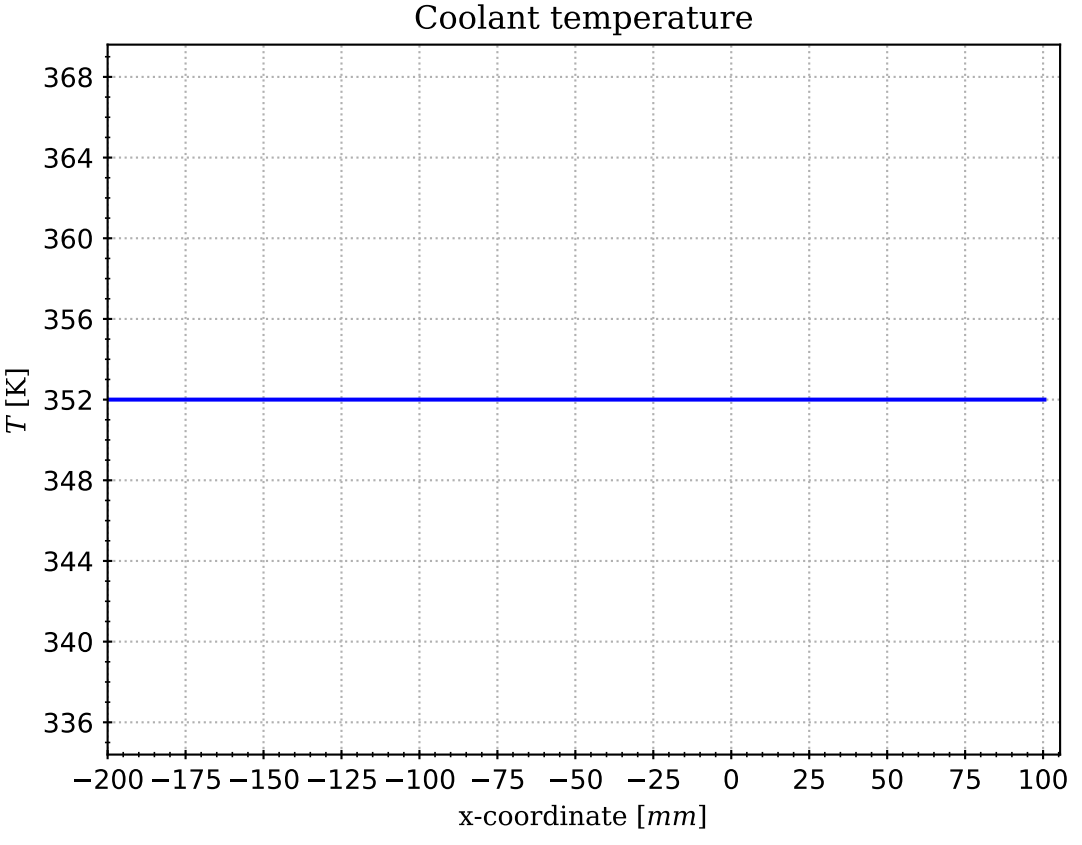

Chamber wall thickness
Wall thickness t [mm]
x-coordinate [mm]
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
−200
−175
−150
−125
−100
−75
−50
−25
0
25
50
75
100

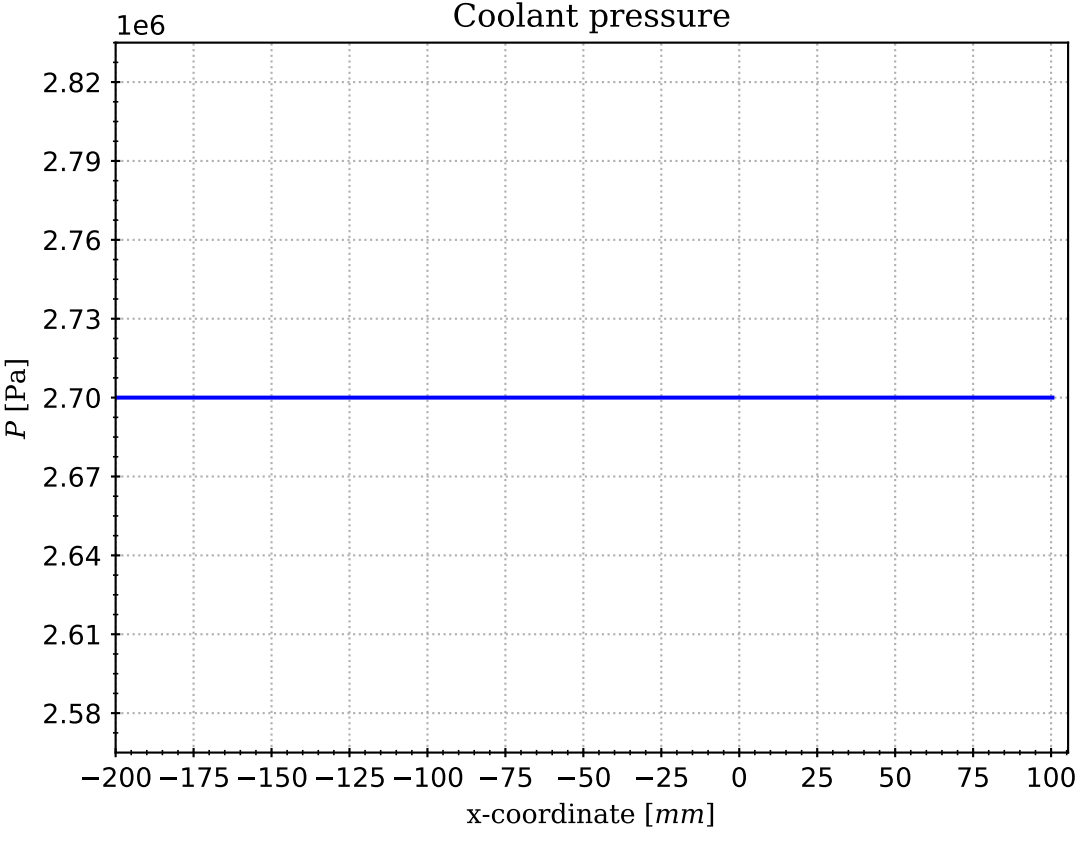

Channel cross-sectional area
1e−6
6.4
5.6
4.8
4.0
3.2
2.4
1.6
0.8
0.0
Area [m^2]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

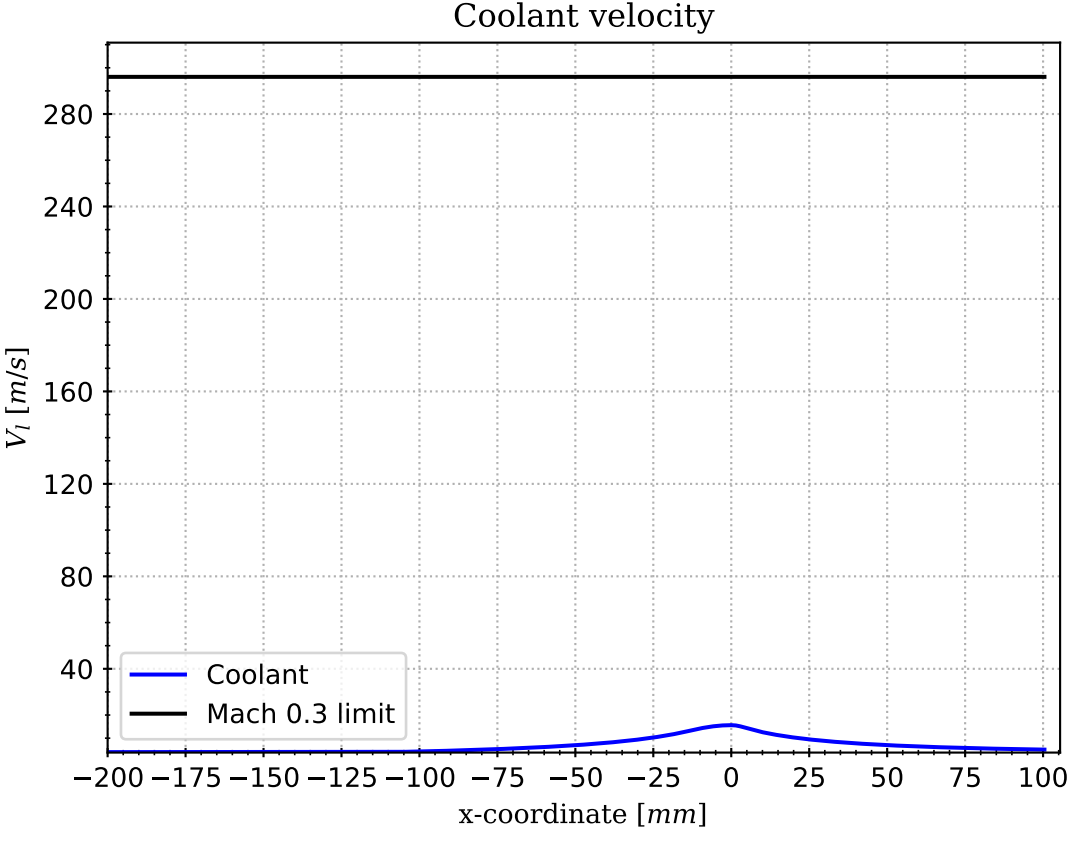

Cold-side convective coefficient h_l
1e7
No correction
Correction 1 (P. Pempie)
Correction 2 (Popp & Schmidt)
h_l $[\frac{W}{m^2 \cdot K}]$
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate $[mm]$

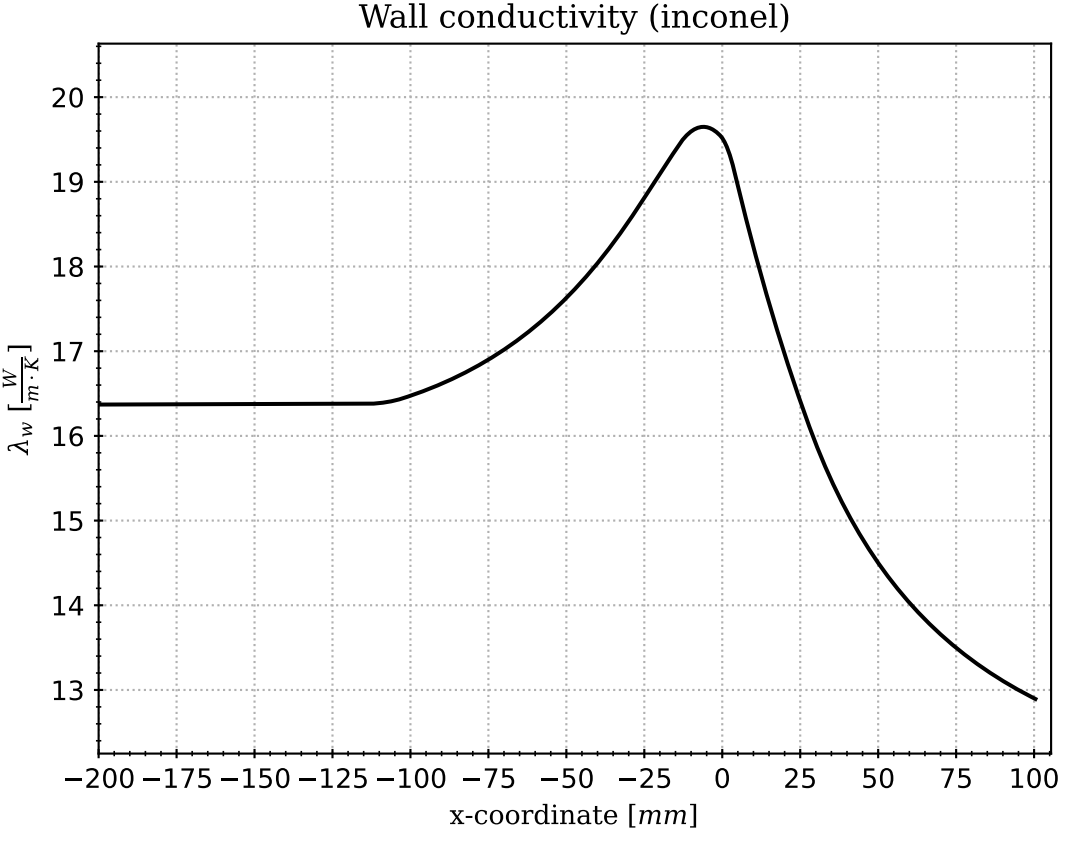

Wall temperatures T_{wg} and T_{wl}
Hot side
Cold side
1350
1200
1050
900
750
600
450
T [K]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

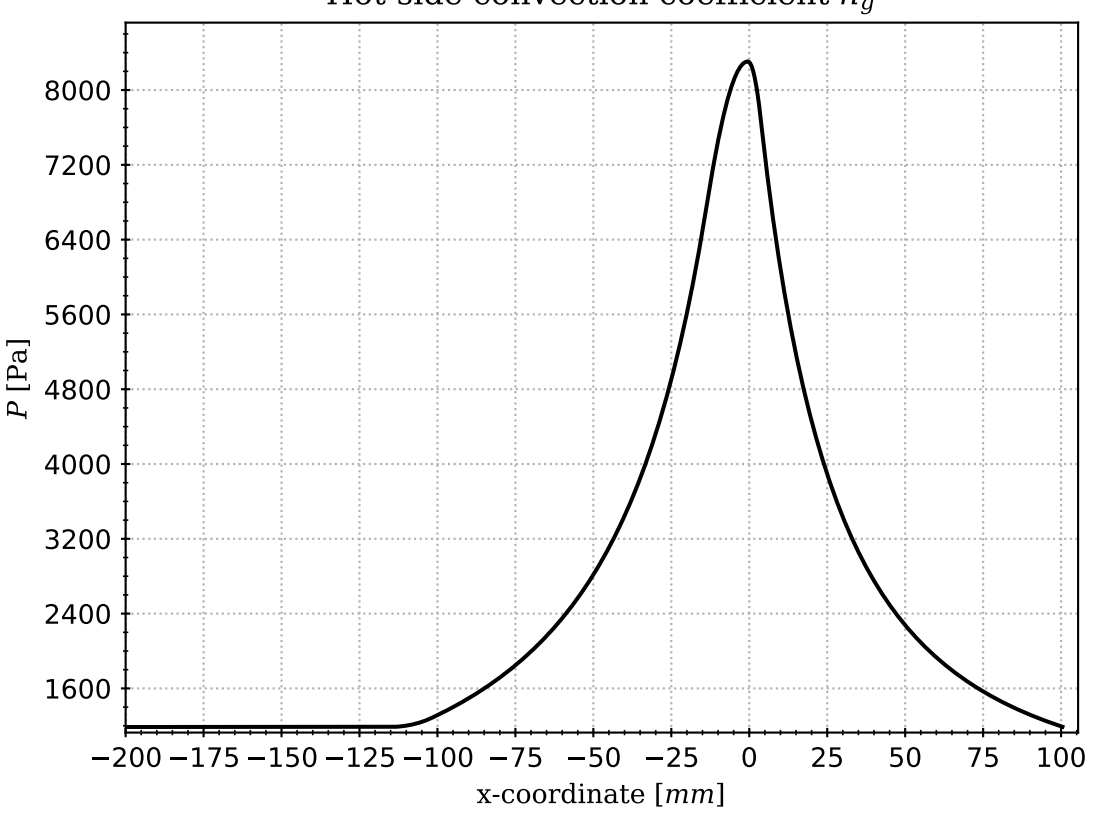

Total heat flux and CHF
1e7
Total heat flux
Critical Heat Flux
1.35
1.20
1.05
0.90
0.75
0.60
0.45
0.30
$\dot{q}$ [$\frac{W}{m^2}$]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

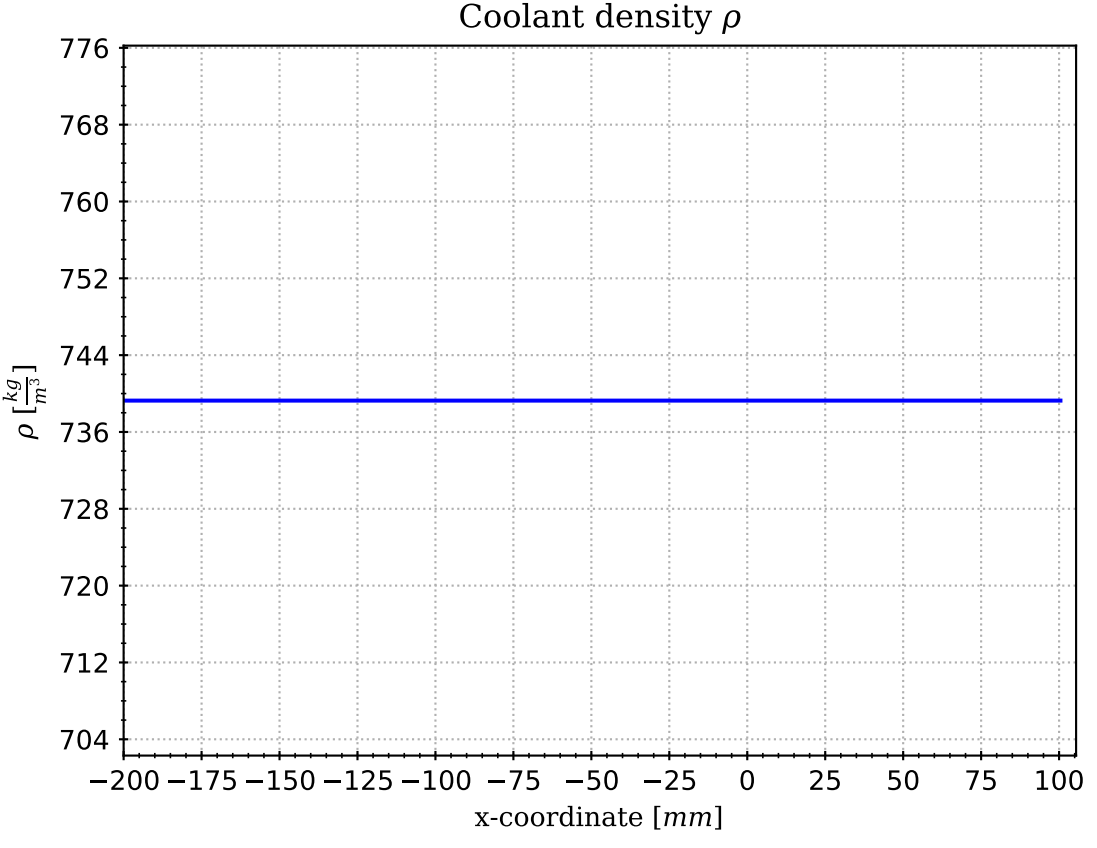

Coolant temperature
368
364
360
356
352
348
344
340
336
T [K]
−200
−175
−150
−125
−100
−75
−50
−25
0
25
50
75
100
x-coordinate [mm]

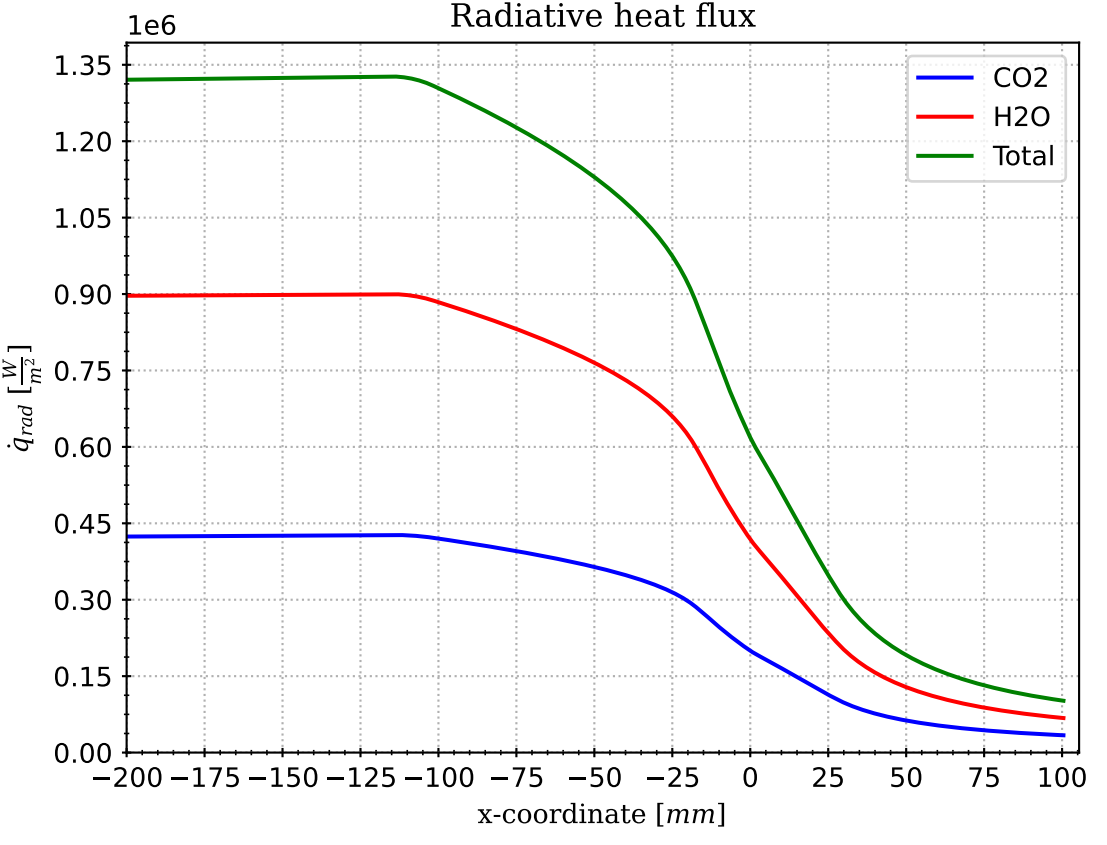

Coolant pressure
1e6
2.82
2.79
2.76
2.73
2.70
2.67
2.64
2.61
2.58
P [Pa]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

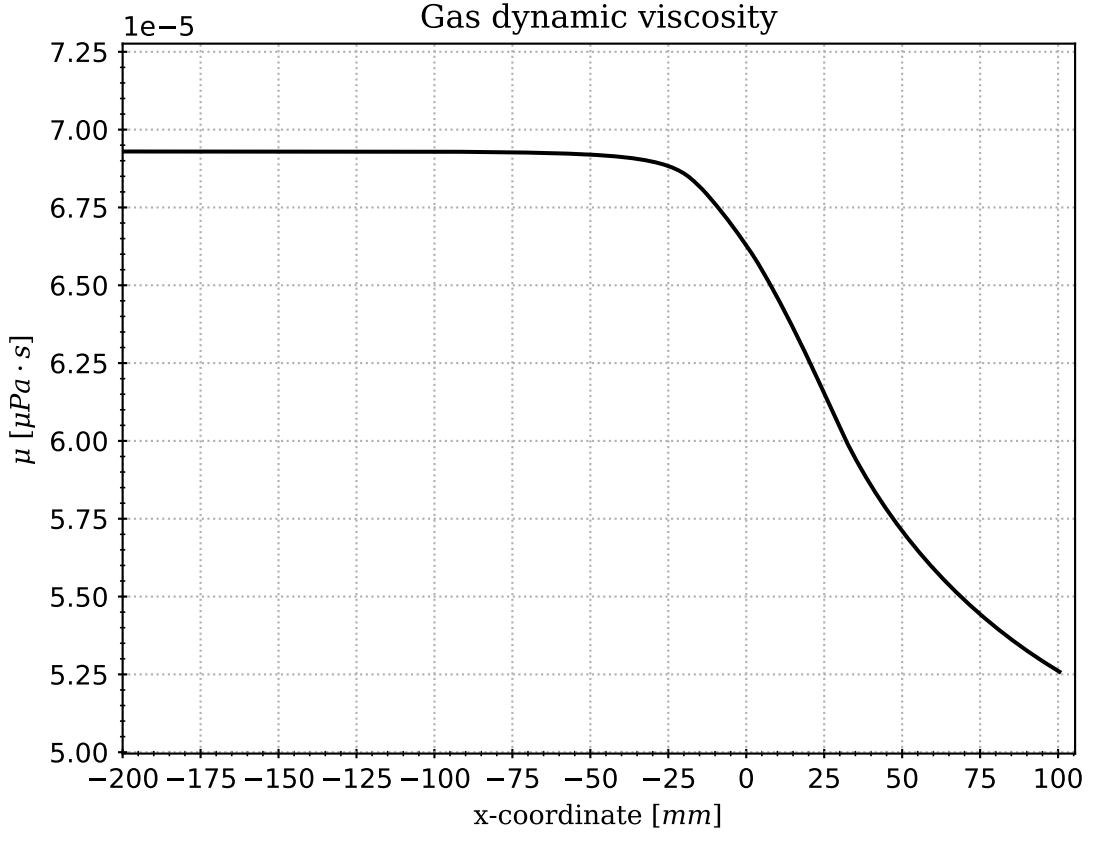

Coolant velocity
280
240
200
160
120
80
40
V_l [m/s]
Coolant
Mach 0.3 limit
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

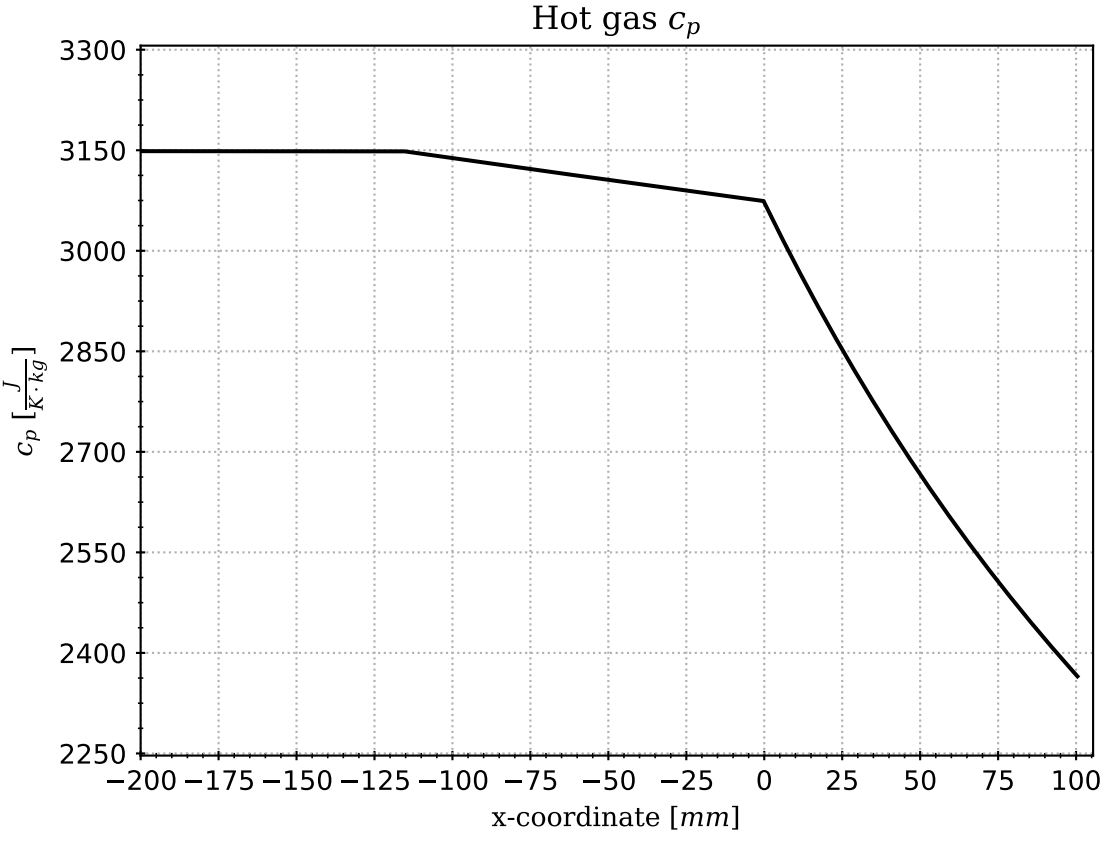

Wall conductivity (inconel)
λ_w $[\frac{W}{m \cdot K}]$
20
19
18
17
16
15
14
13
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

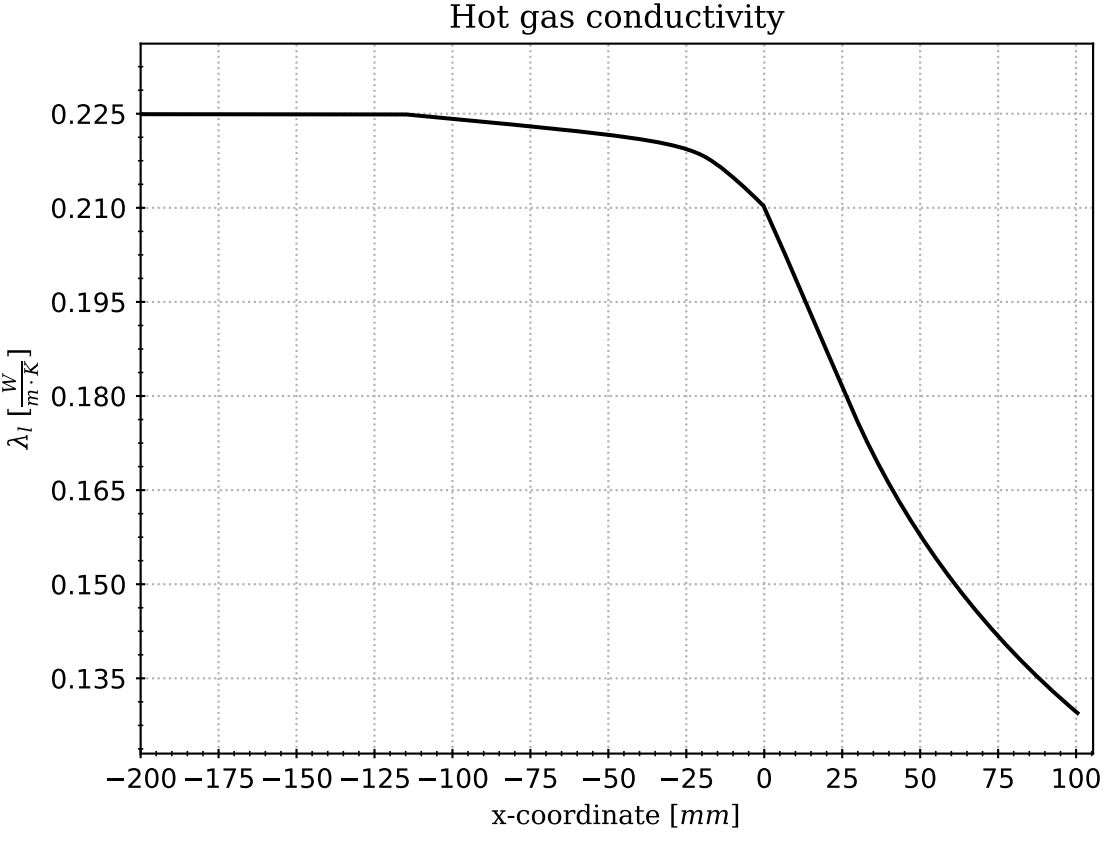

Hot-side convection coefficient h_g
8000
7200
6400
5600
4800
4000
3200
2400
1600
P [Pa]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

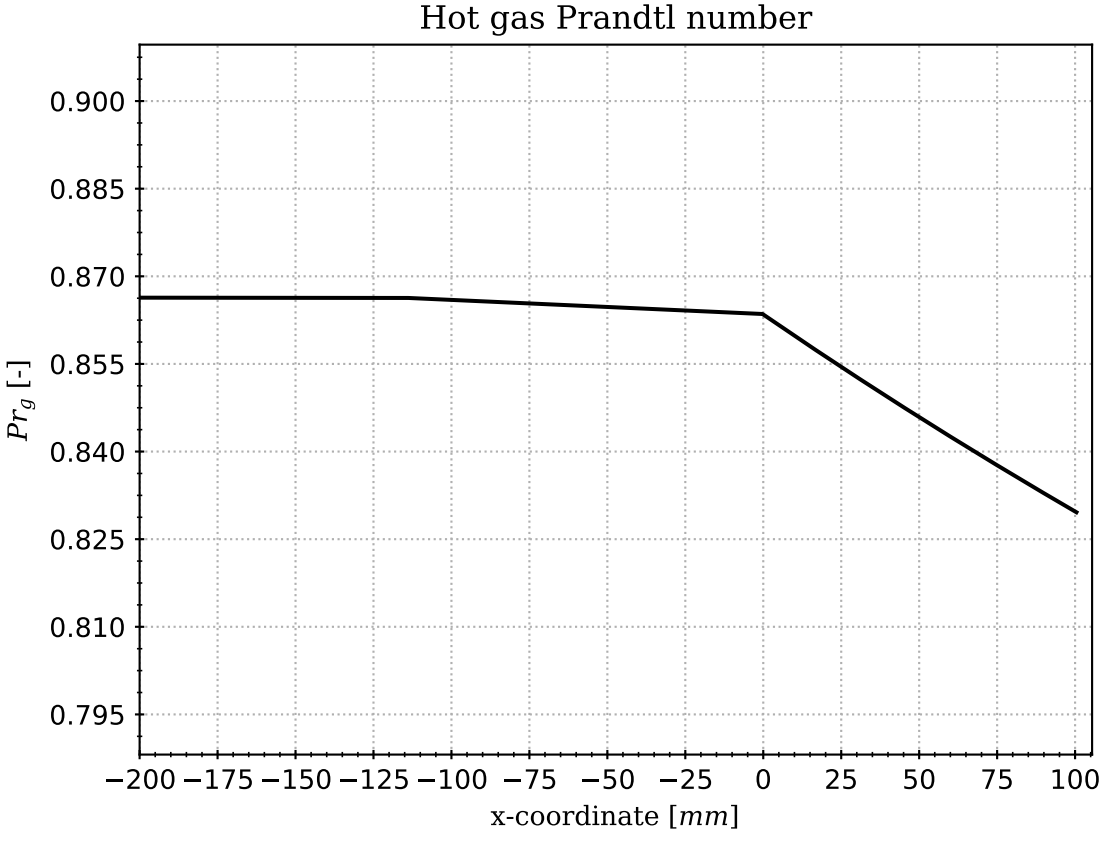

Coolant density ρ
776
768
760
752
744
736
728
720
712
704
ρ [$\frac{kg}{m^3}$]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

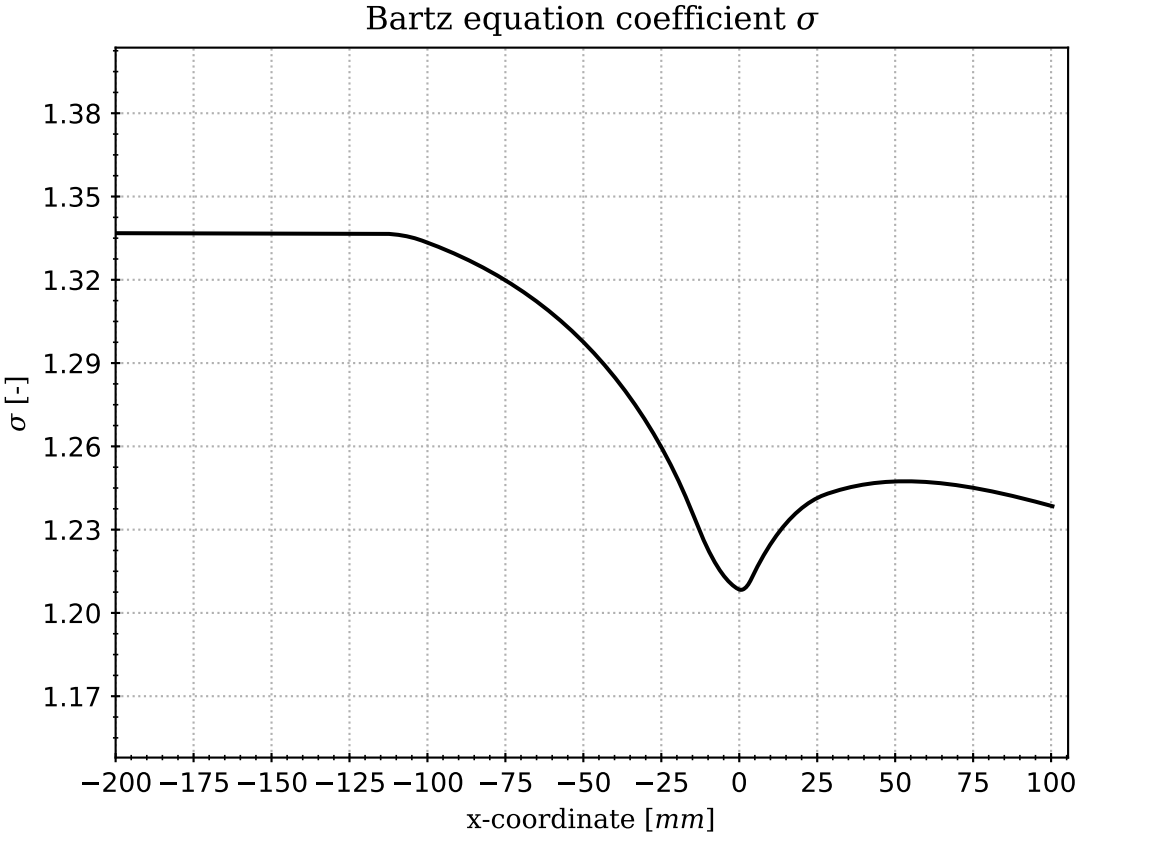

Radiative heat flux
1e6
1.35
1.20
1.05
0.90
0.75
0.60
0.45
0.30
0.15
0.00
$\dot{q}_{rad}$ $[\frac{W}{m^2}]$
CO2
H2O
Total
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

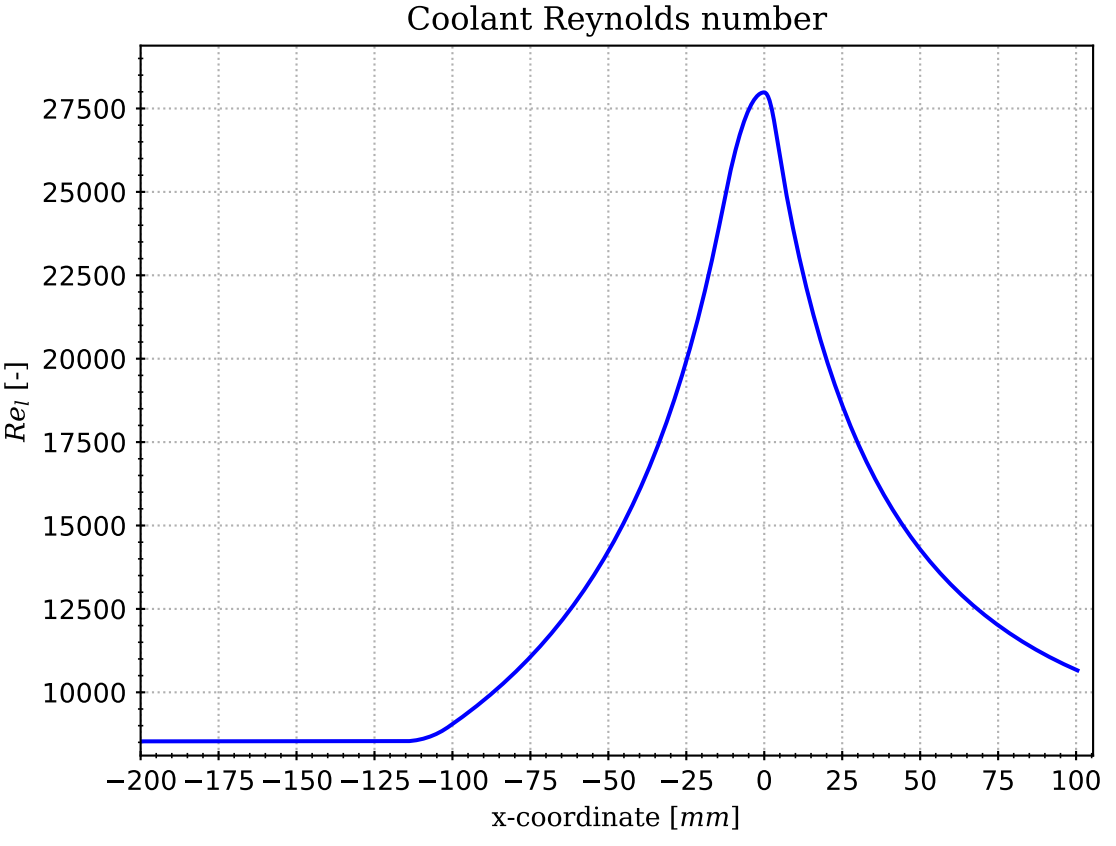

Gas dynamic viscosity
1e−5
7.25
7.00
6.75
6.50
6.25
6.00
5.75
5.50
5.25
5.00
μ [$\mu Pa \cdot s$]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

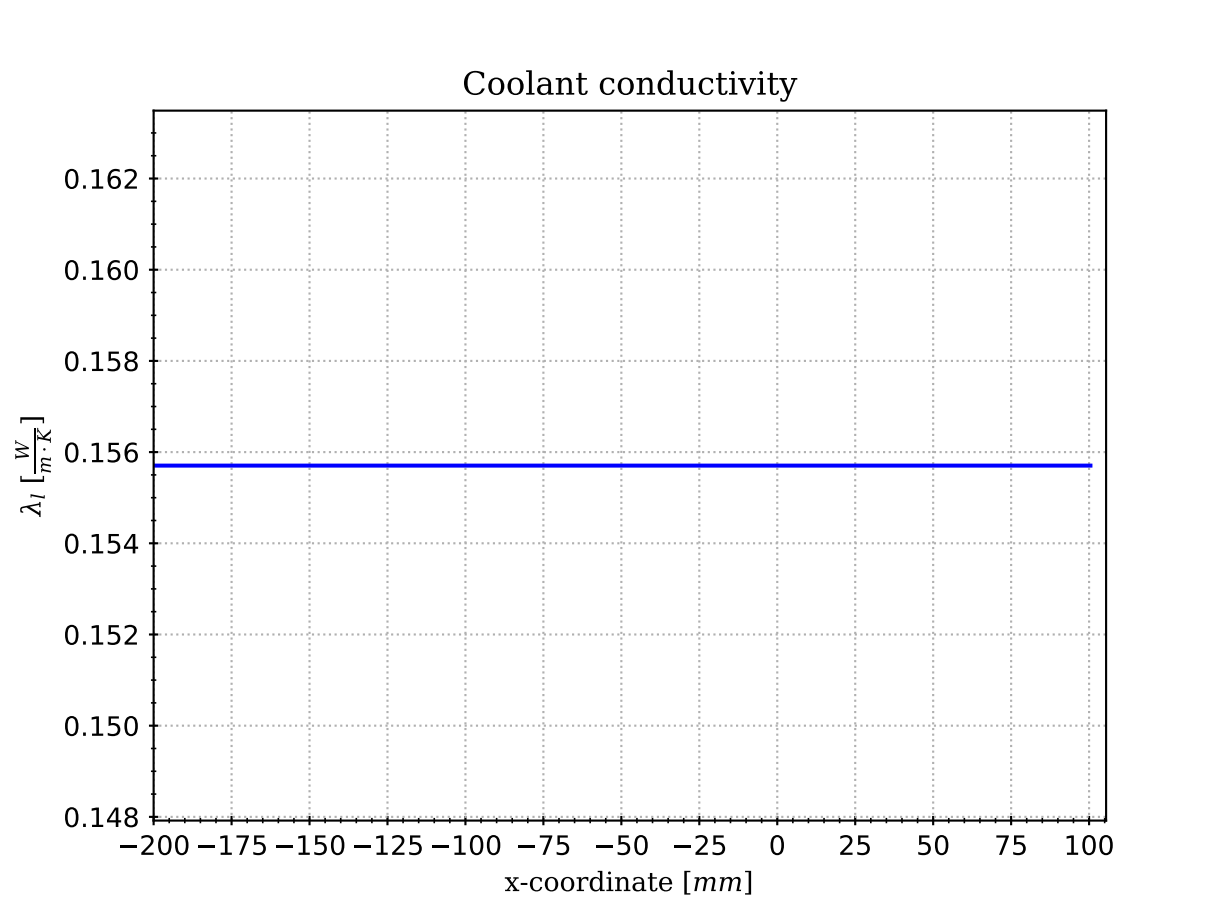

Hot gas c_p
3300
3150
3000
2850
2700
2550
2400
2250
c_p $[\frac{J}{K \cdot kg}]$
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate $[mm]$

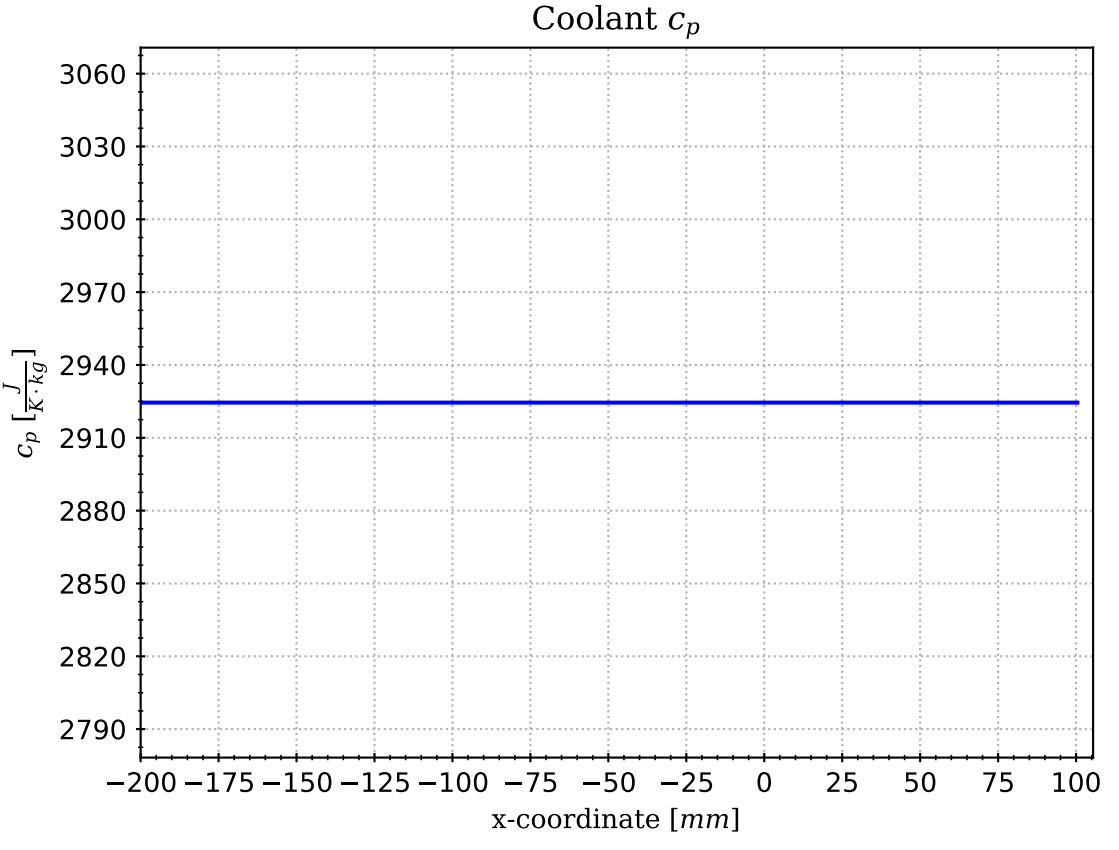

Hot gas conductivity
0.225
0.210
0.195
0.180
0.165
0.150
0.135
λ_l [$\frac{W}{m \cdot K}$]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

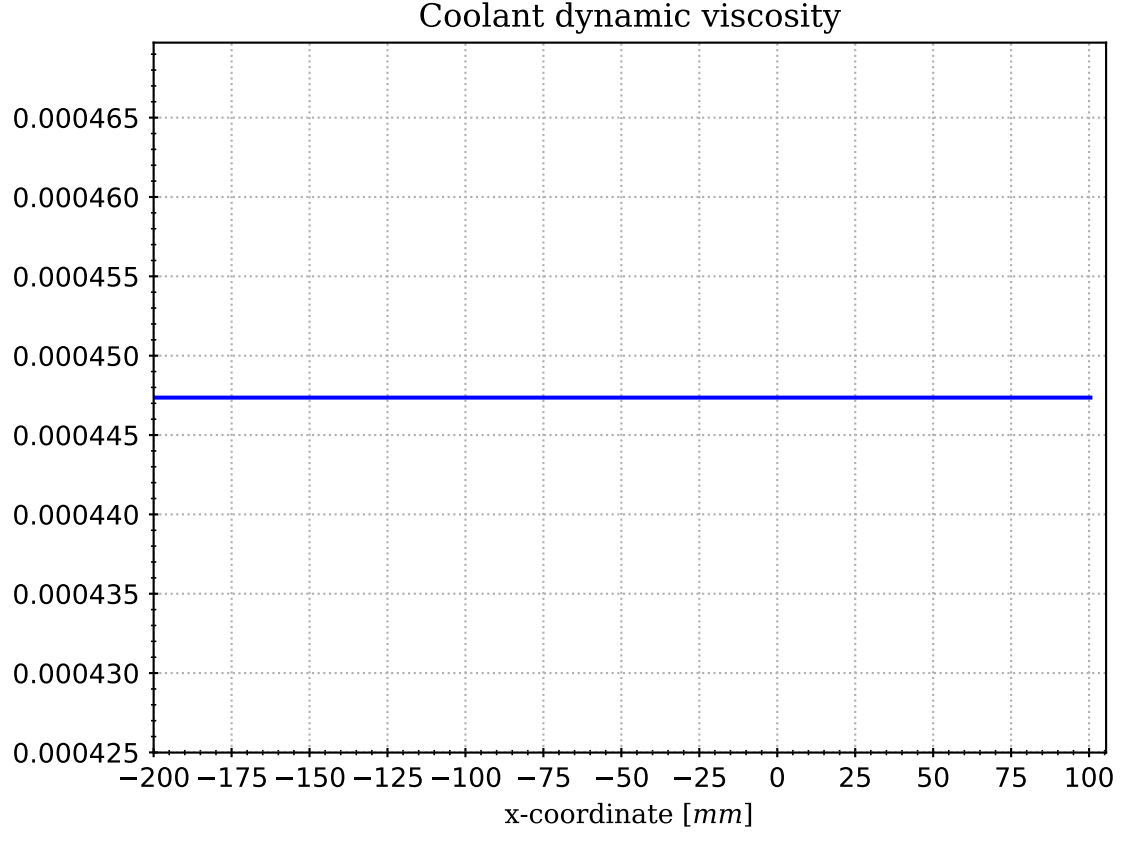

Hot gas Prandtl number
0.900
0.885
0.870
0.855
0.840
0.825
0.810
0.795
Pr_g [-]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]

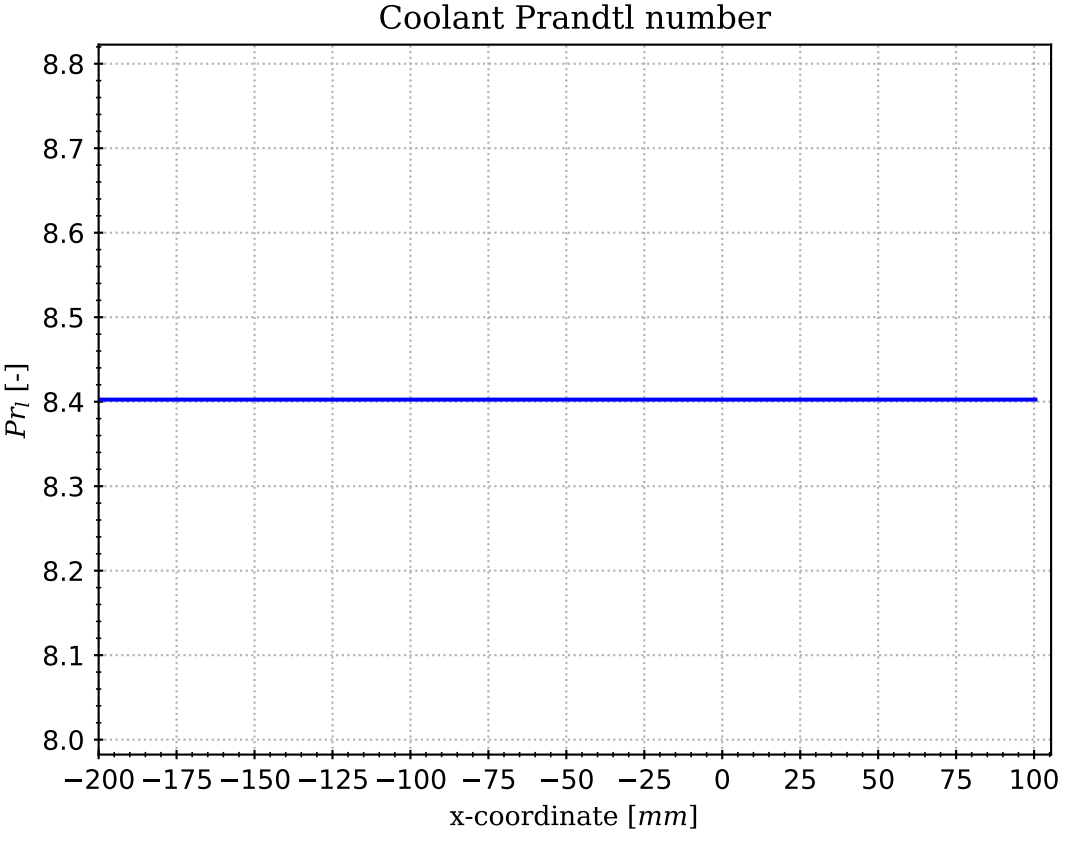

Bartz equation coefficient σ
1.38
1.35
1.32
1.29
1.26
1.23
1.20
1.17
σ [-]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]


Coolant Reynolds number
Re_l [-]
27500
25000
22500
20000
17500
15000
12500
10000
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]


Coolant conductivity
0.162
0.160
0.158
0.156
0.154
0.152
0.150
0.148
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
3060
3030
3000
2970
2940
2910
2880
2850
2820
2790
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
0.000465
0.000460
0.000455
0.000450
0.000445
0.000440
0.000435
0.000430
0.000425
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]


Coolant Prandtl number
8.8
8.7
8.6
8.5
8.4
8.3
8.2
8.1
8.0
Pr_l [-]
−200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100
x-coordinate [mm]