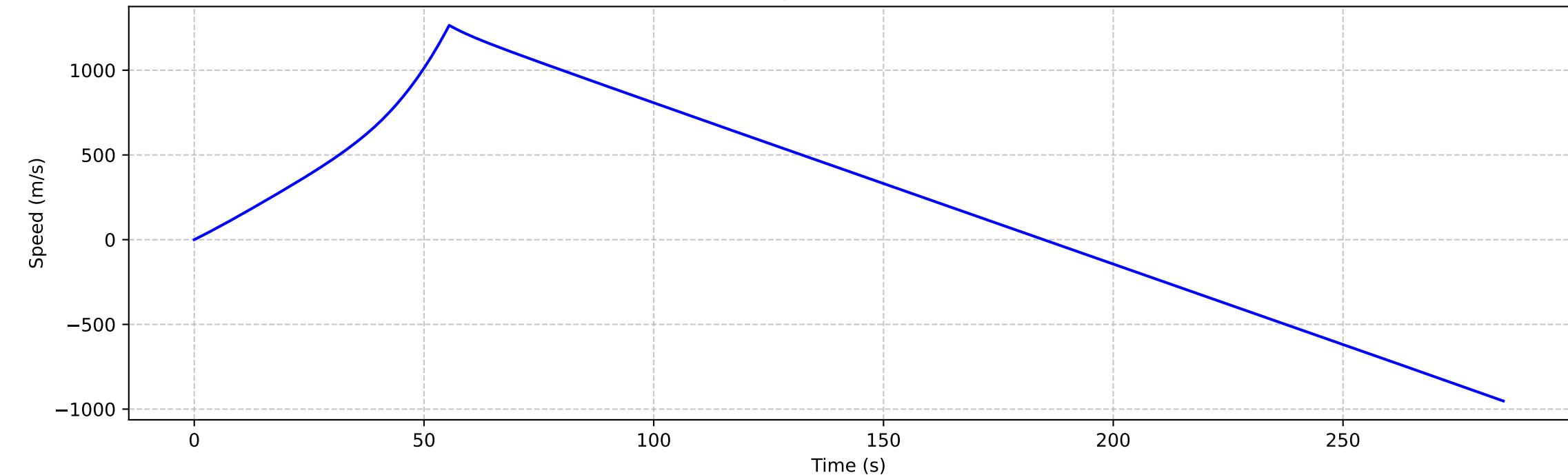
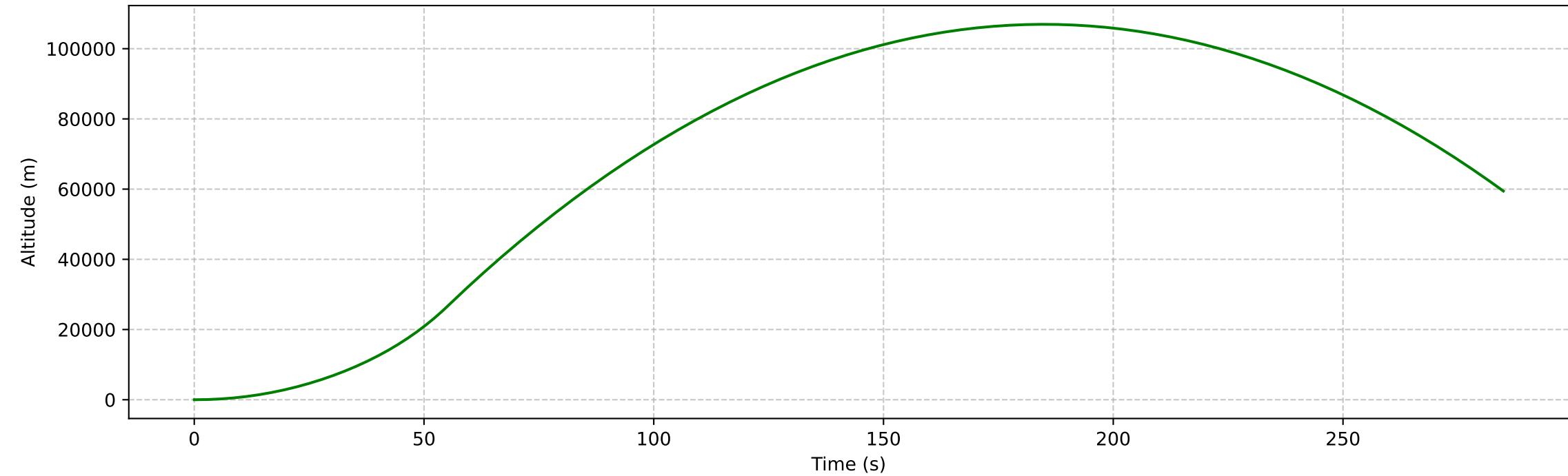


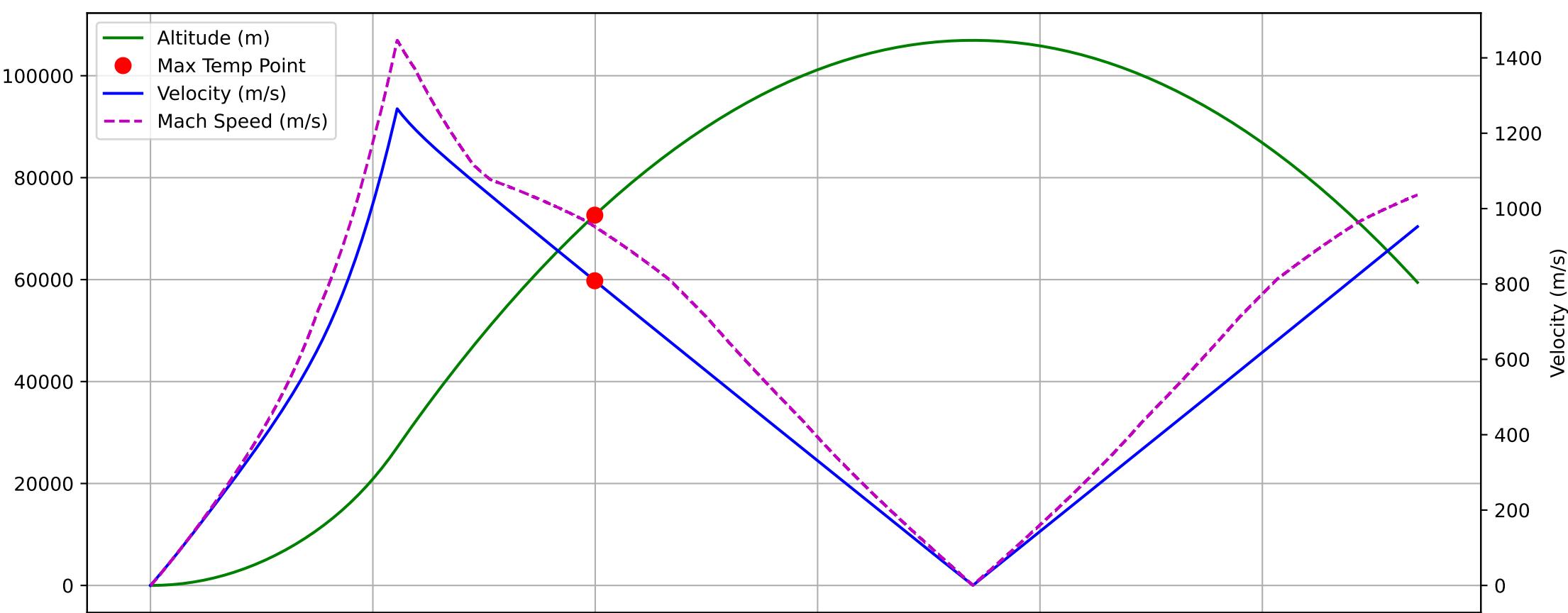
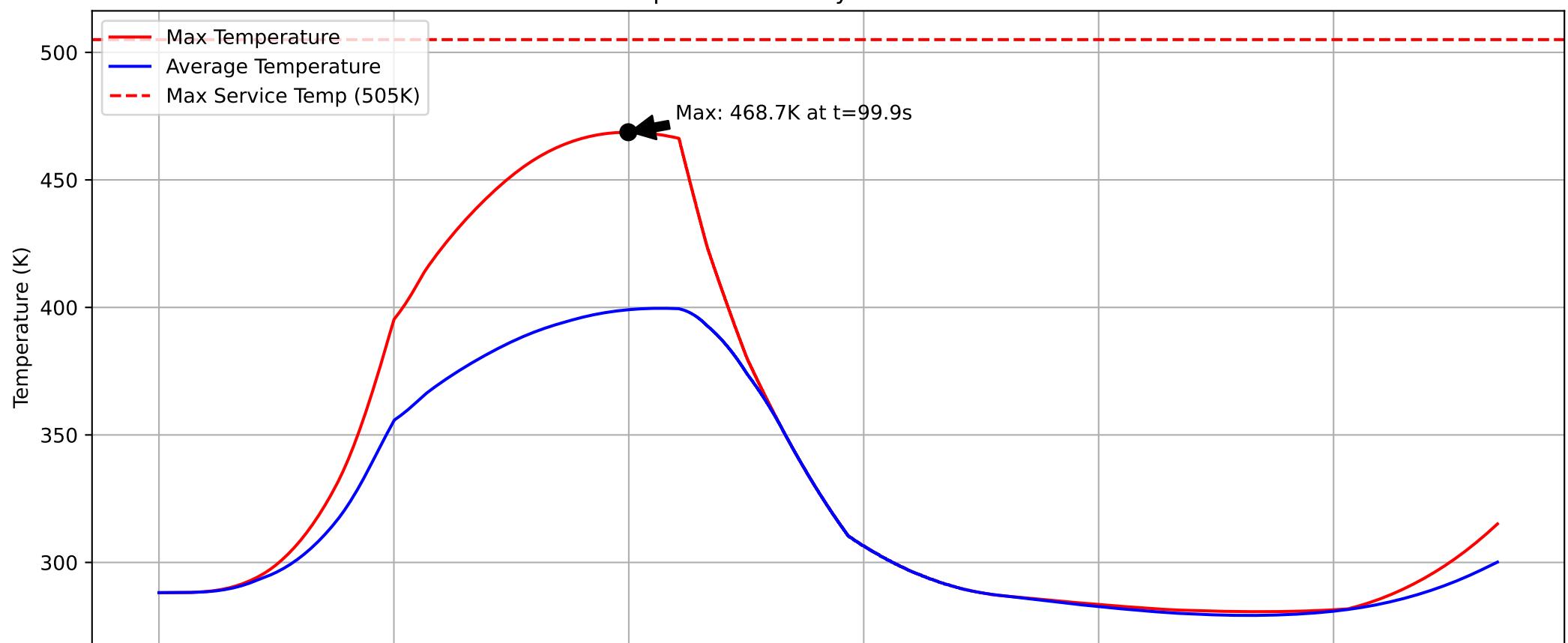
Speed vs Time



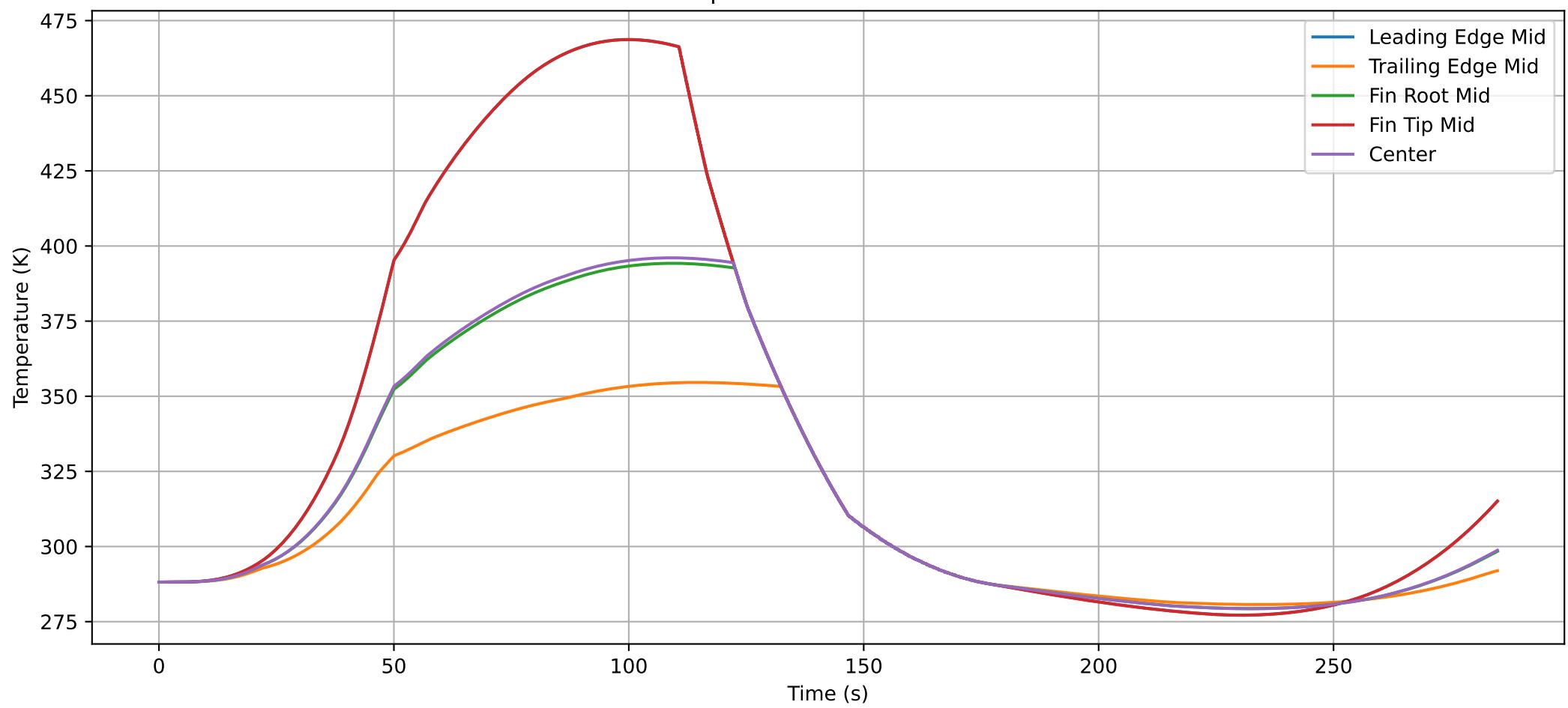
Altitude vs Time



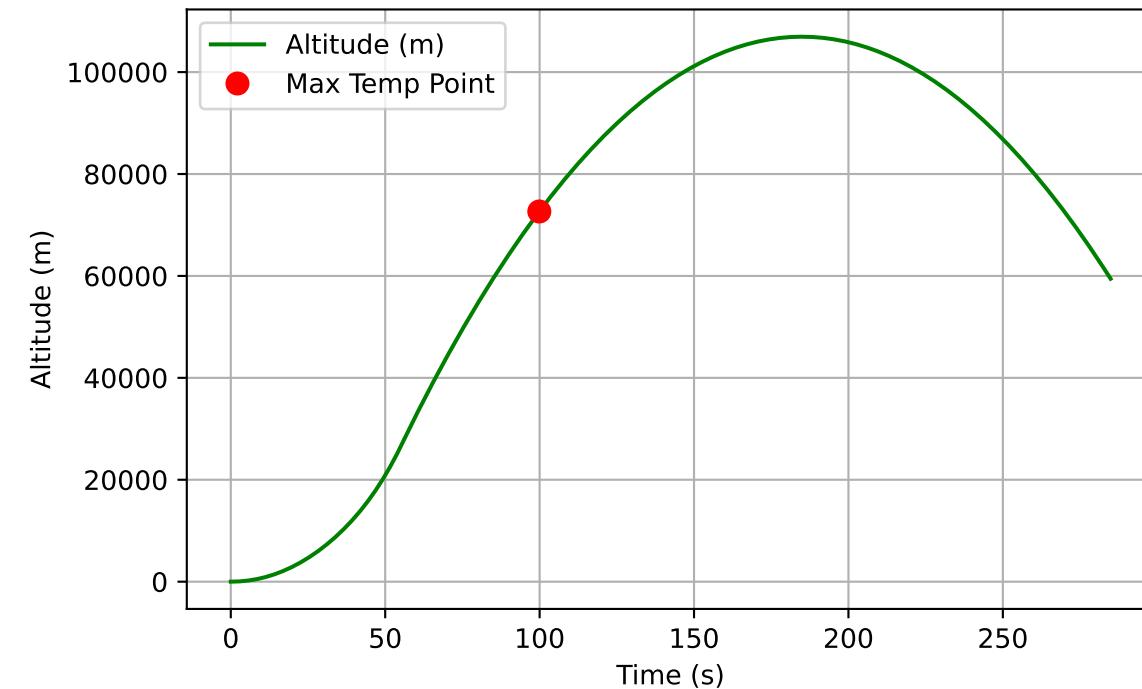
### Fin Temperature History - Titanium Ti-6Al-4V



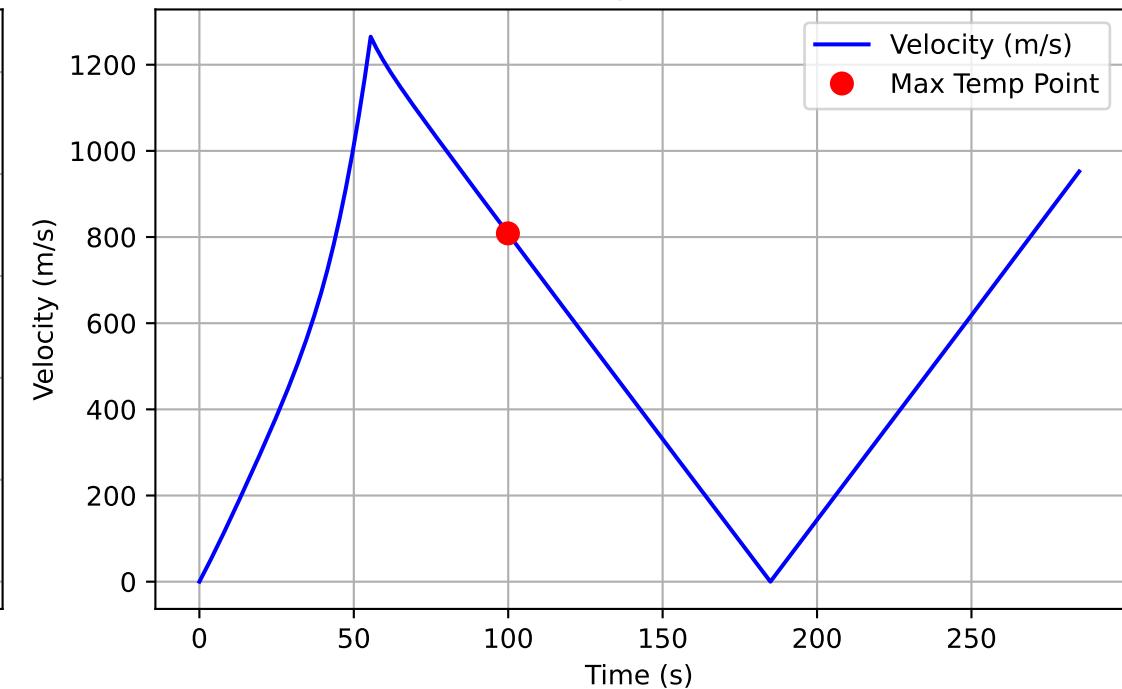
Temperature at Track Points



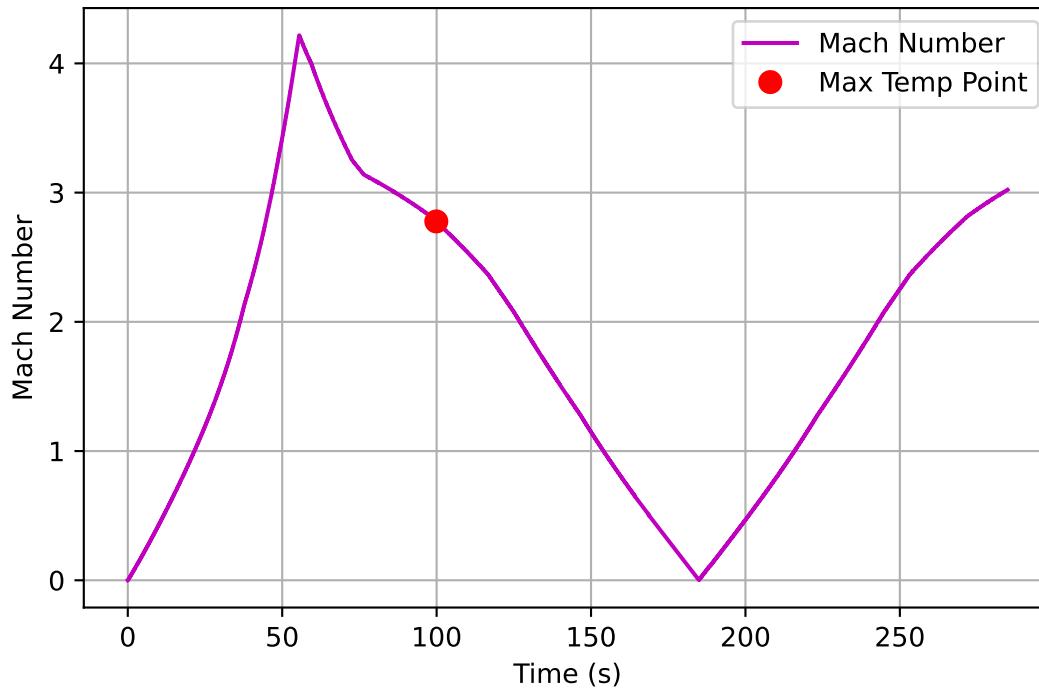
### Altitude vs Time



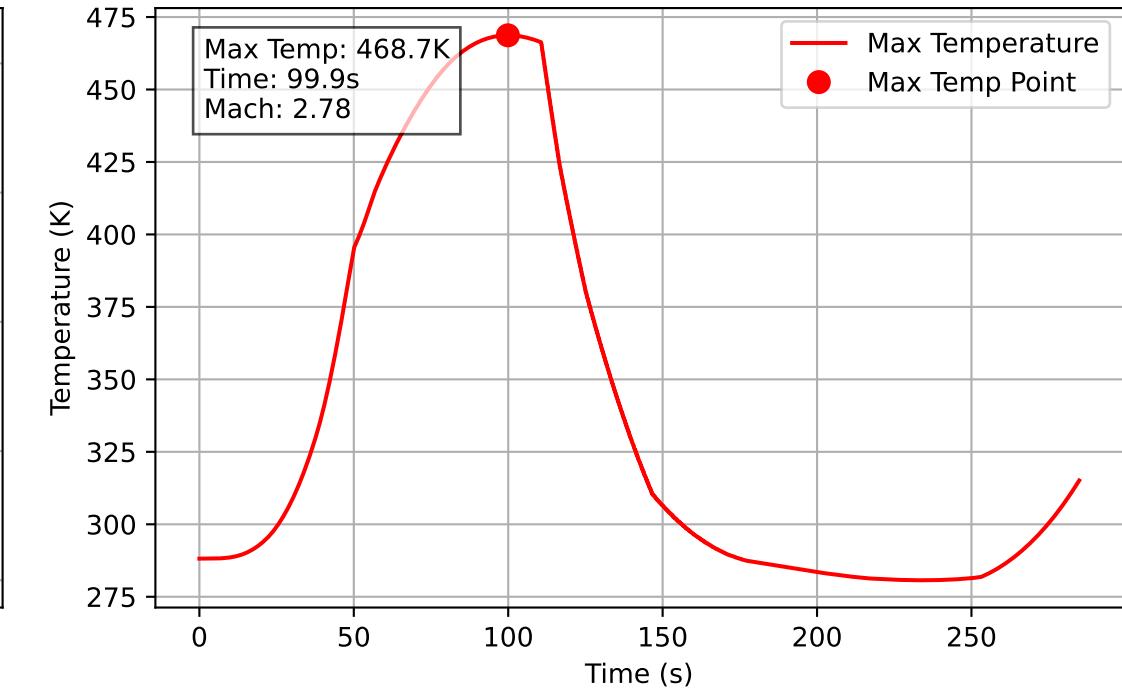
### Velocity vs Time



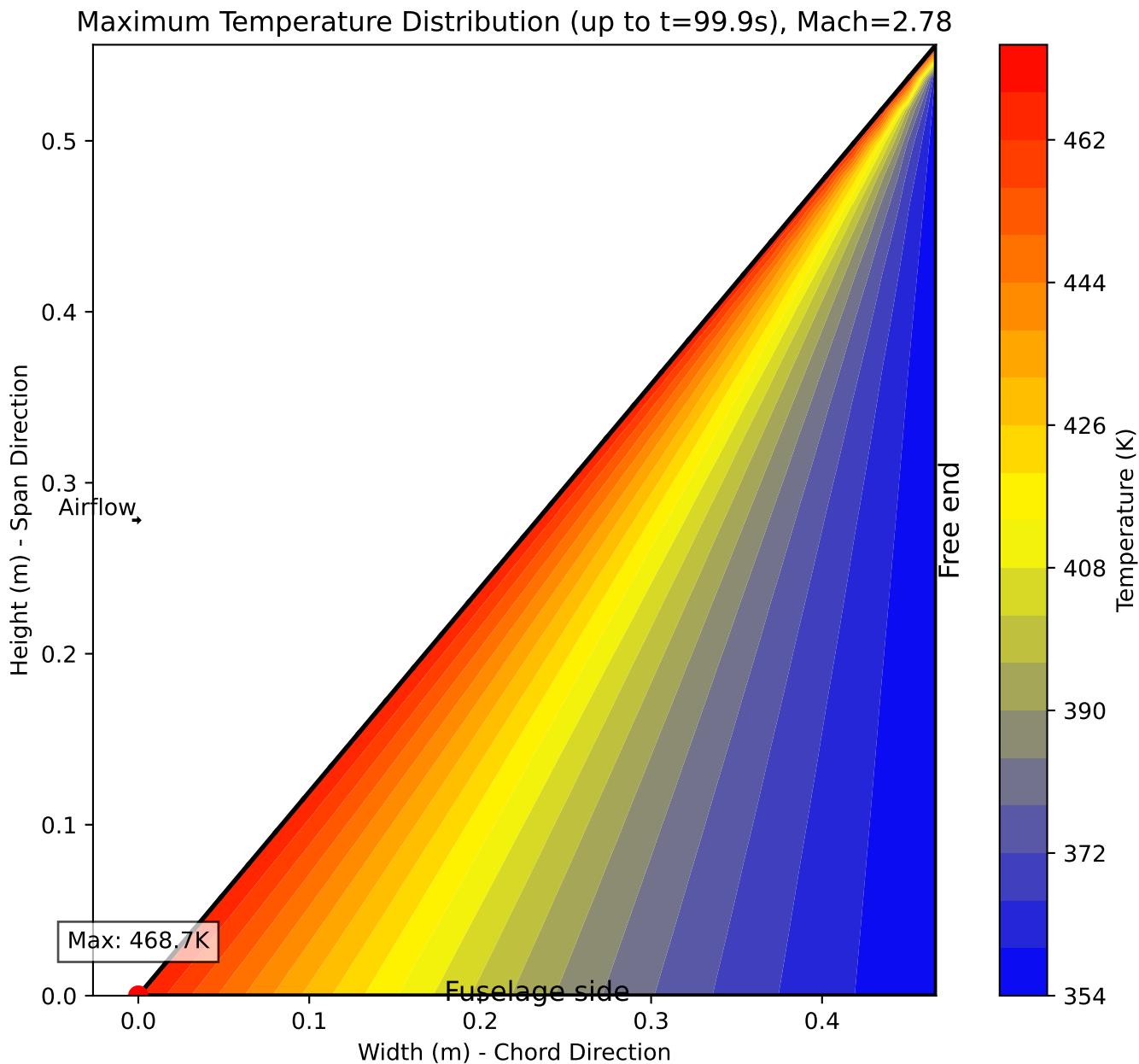
### Mach Number vs Time



### Maximum Temperature vs Time



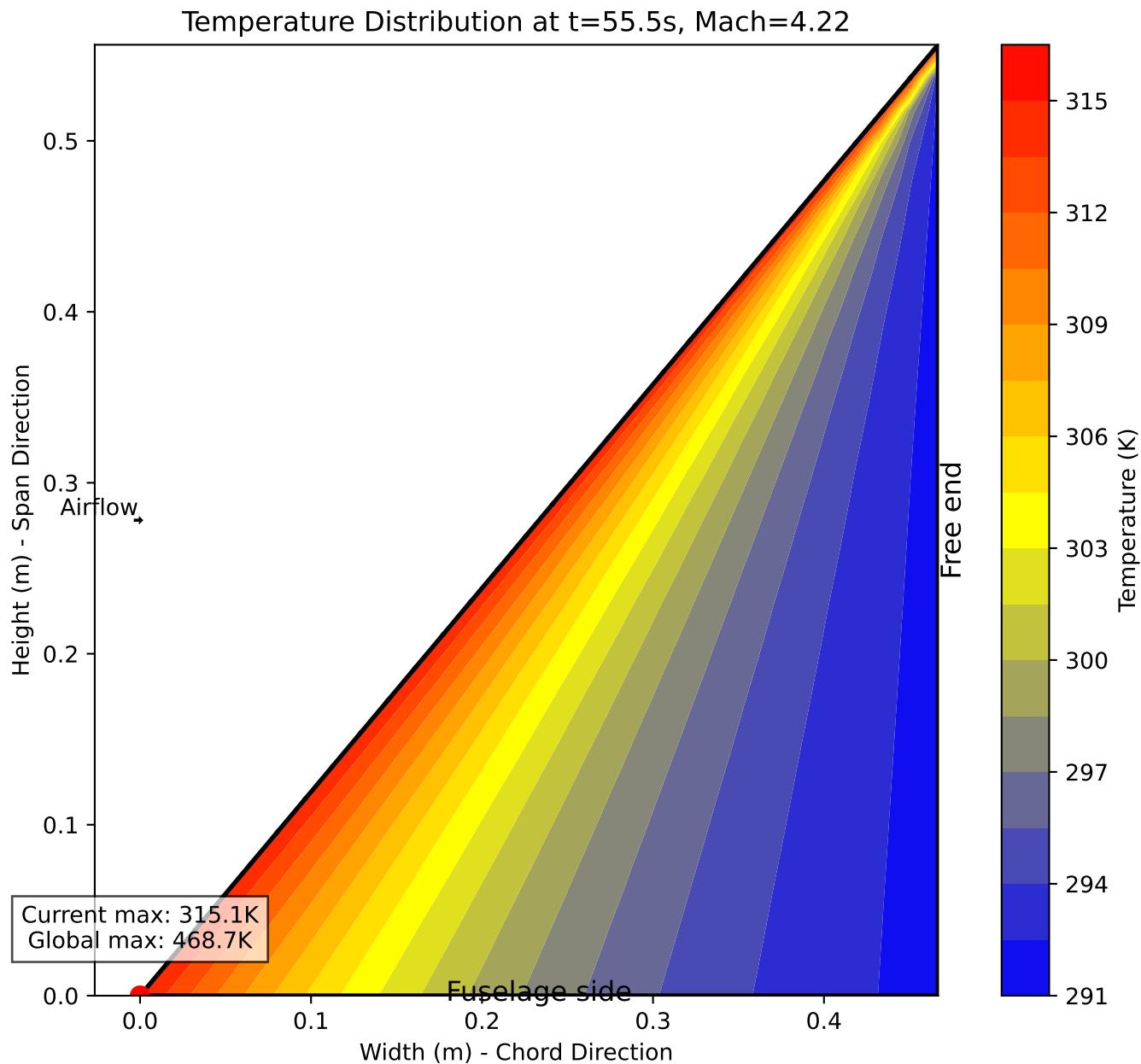
# Temperature Distribution at Maximum Temperature



Flight Conditions:  
Time: 99.9 s  
Velocity: 808.5 m/s  
Altitude: 72646.8 m  
Mach: 2.78

Material: Titanium Ti-6Al-4V  
Max Service Temp: 505 K  
Peak Fin Temp: 468.7 K  
Safety Margin: 36.3 K

# Temperature Distribution at Maximum Velocity



Flight Conditions:  
Time: 55.5 s  
Velocity: 1265.0 m/s  
Altitude: 27079.4 m  
Mach: 4.22

Material: Titanium Ti-6Al-4V  
Max Service Temp: 505 K  
Peak Fin Temp: 468.7 K  
Safety Margin: 36.3 K

# INITIAL CONDITIONS AND PARAMETERS

## FLIGHT SIMULATION

Generated: 2023-11-12 08:27:14

### SIMULATION PARAMETERS

|                    |                    |
|--------------------|--------------------|
| Fin Material:      | Titanium Ti-6Al-4V |
| Fast Mode:         | False              |
| Time Step (dt):    | 0.01 s             |
| After Top Reached: | 10000 cycles       |
| Animation Enabled: | False              |

### COMPONENT MASSES AND POSITIONS

| Component          | Mass (kg) | Position (m) | Team     |
|--------------------|-----------|--------------|----------|
| nose_cone          | 10.230    | 0.450        | aero     |
| fuselage_oxi       | 55.330    | 4.500        | fuselage |
| propellant         | 244.080   | 3.000        | fuselage |
| helium_tank        | 43.500    | 1.400        | fuselage |
| fuselage_shell     | 60.250    | 4.000        | fuselage |
| combustion_chamber | 12.830    | 5.500        | fuselage |
| nozzle             | 7.993     | 7.349        | nozzle   |
| fins (calculated)  | 8.162     | 2.100        | aero     |
| Total Dry Mass     | 198.295   |              |          |
| Total Propellant   | 244.080   |              |          |
| Total Mass         | 442.375   |              |          |
| Mass Ratio         | 2.231     |              |          |

### ROCKET GEOMETRY

|                   |         |
|-------------------|---------|
| Rocket Length:    | 2.5 m   |
| Rocket Diameter:  | 0.5 m   |
| Rocket Radius:    | 0.175 m |
| Nose Cone Length: | 0.3 m   |
| Nose Cone Shape:  | ogive   |

### ENGINE PARAMETERS

|                 |          |
|-----------------|----------|
| ISP Sea Level:  | 235 s    |
| ISP Vacuum:     | 300 s    |
| Fuel Flow Rate: | 4.4 kg/s |

### INITIAL CONDITIONS

|                           |       |
|---------------------------|-------|
| Initial Velocity:         | 0 m/s |
| Initial Altitude:         | 0 m   |
| Initial Dynamic Pressure: | 0 Pa  |

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### AERODYNAMIC PARAMETERS

|                       |            |
|-----------------------|------------|
| Drag Coefficient:     | 0.5        |
| Max Dynamic Pressure: | 82800.0 Pa |

## **INITIAL CONDITIONS (CONTINUED) - PAGE 2**

### **FLIGHT SIMULATION**

Fin Width: 466.72 mm  
Fin Mass (single): 2.040431 kg  
Total Fin Mass: 8.161724 kg  
Wall Thickness: 4 mm  
Fin Set CG Position: 2.1 m

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#### **MATERIAL PROPERTIES**

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Thermal Conductivity: 25 W/(m·K)  
Density: 3930 kg/m<sup>3</sup>  
Specific Heat: 610 J/(kg·K)  
Max Service Temperature: 505 K  
Yield Strength: 1050 MPa  
Thermal Expansion: 6.6e-06 1/K  
Emissivity: 0.63