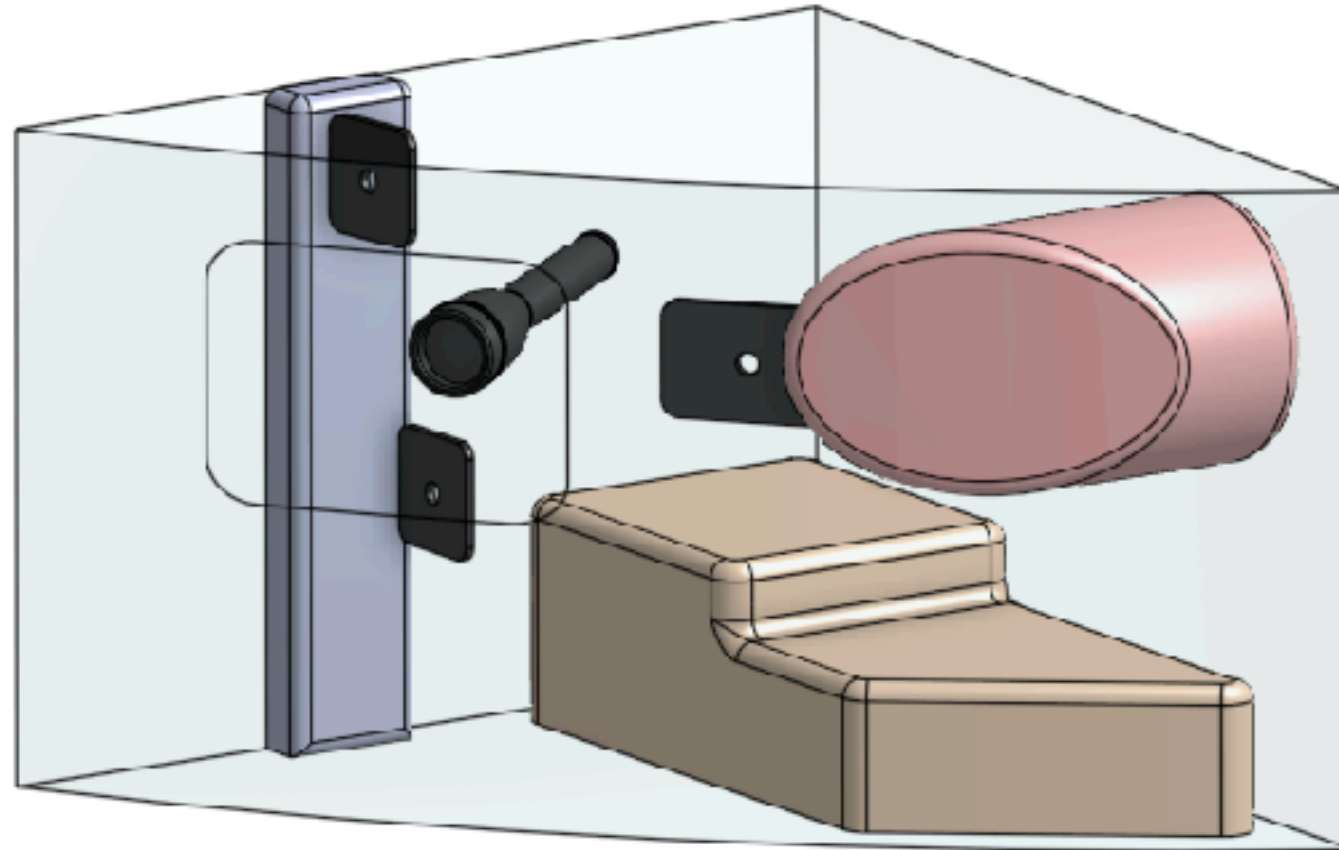
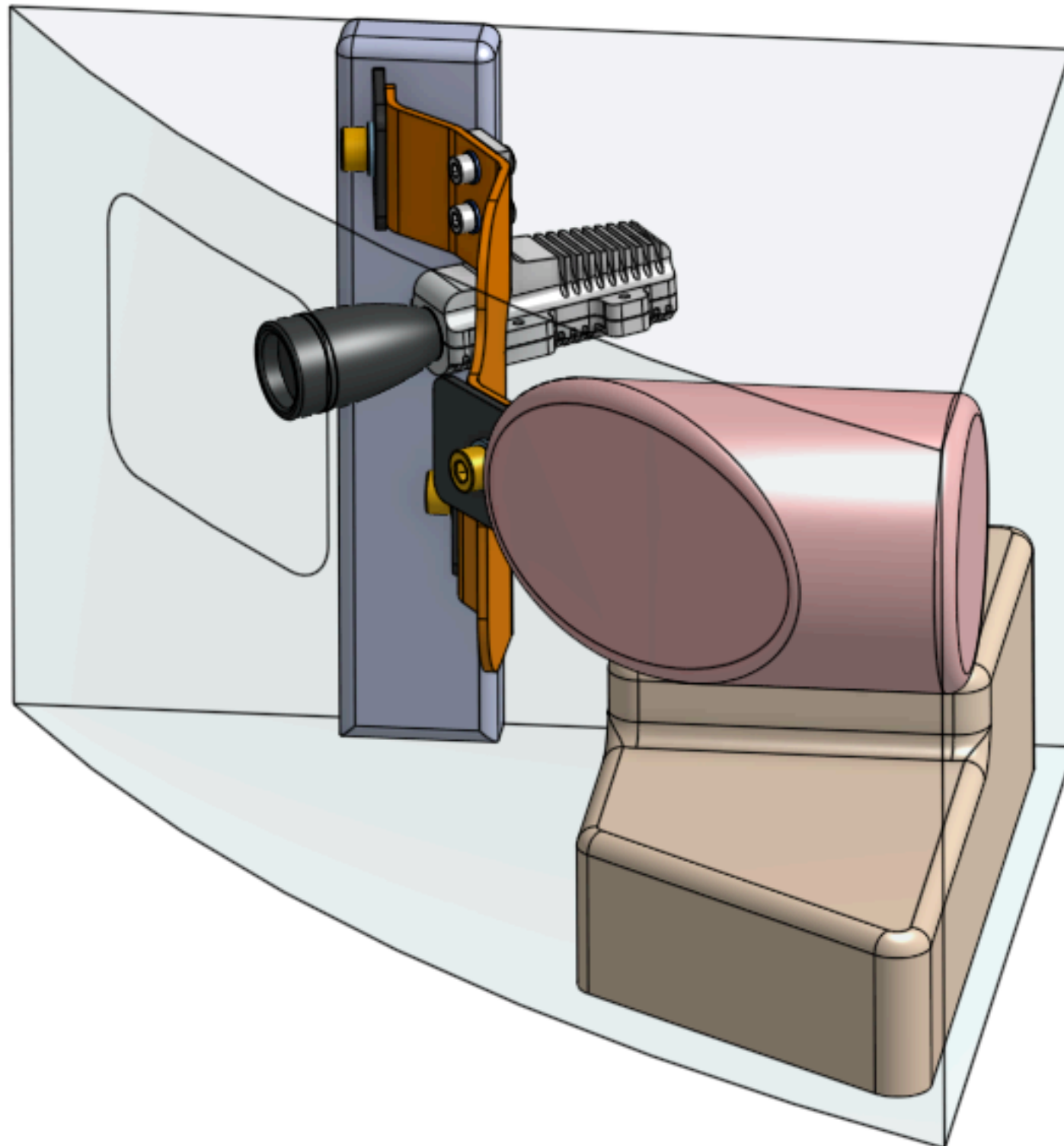


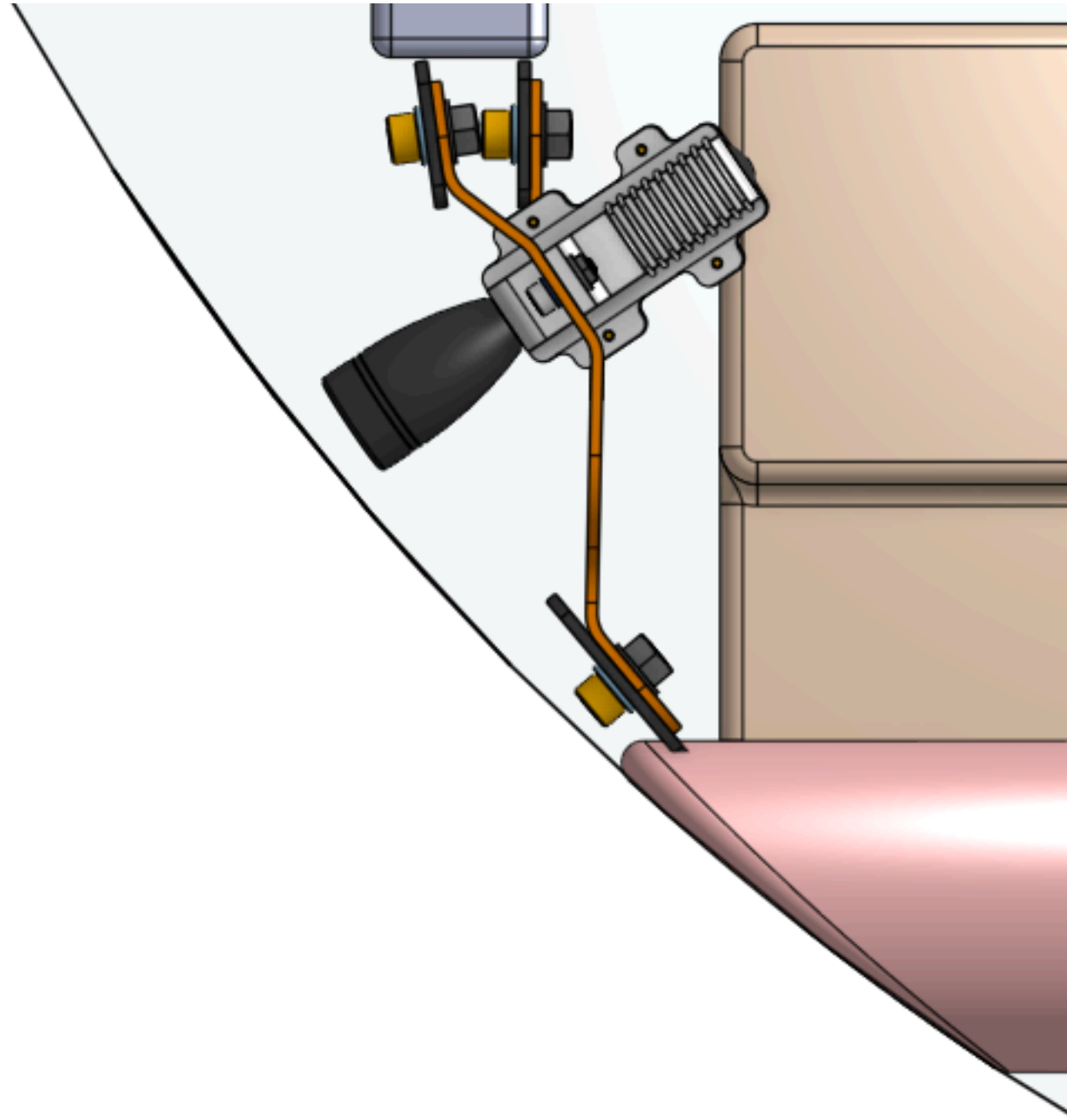
# Flashlight Mount Problem



- **Mount flashlight in exact position rigidly**
- **Dissipate 30W uniformly along flashlight handle**
- **Max housing temperature of 85 °C**
- **Avoid mounting obstacles**

# Solution





# Materials

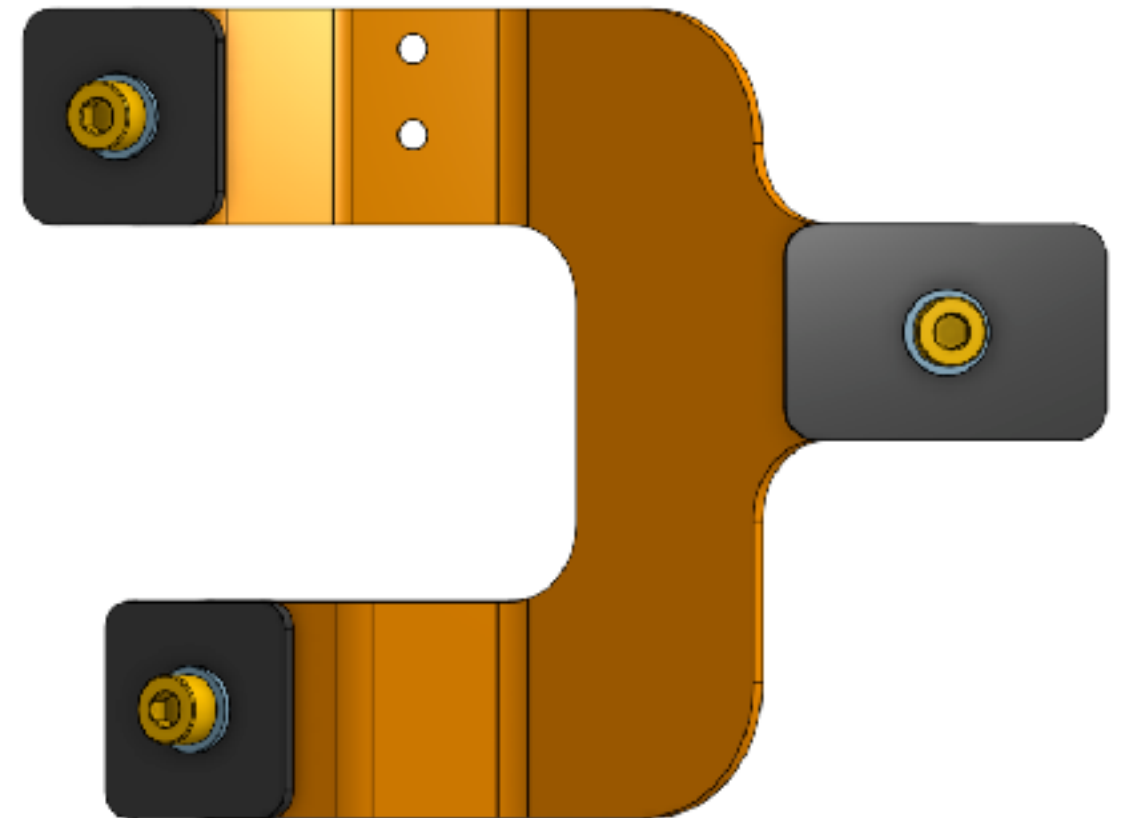
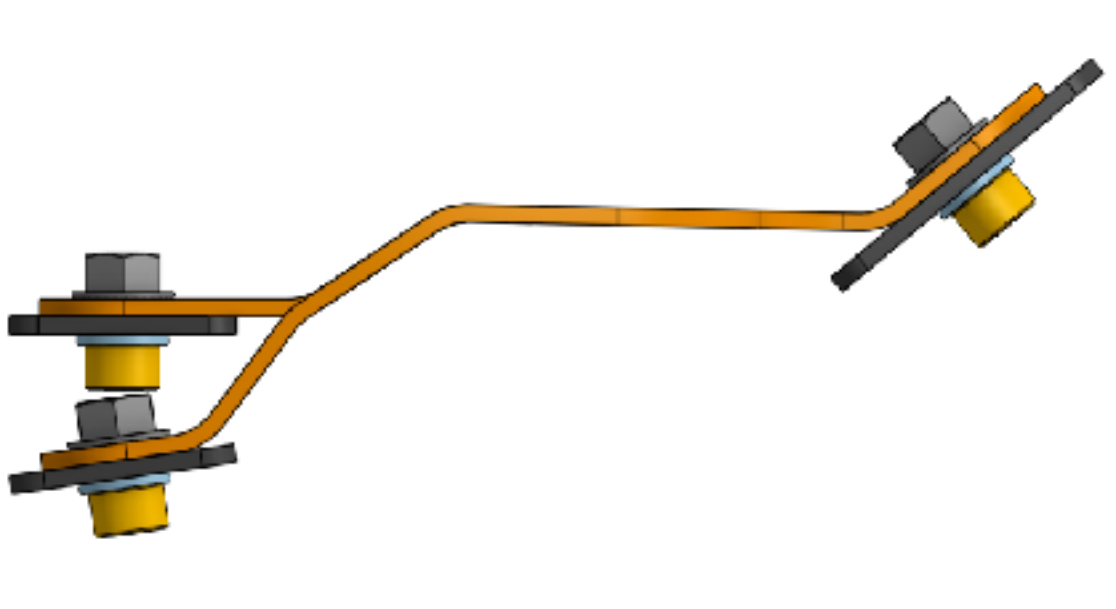
Mount Panel	Aluminum 6061-T6
Top Half Cover	Aluminum 6061-T6
Bottom Half Cover	Aluminum 6061-T6
Flashlight (approximate as solid)	Aluminum 6061-T6

6061 T6 offers good strength, thermal conductivity and machinability

Thermal Conductivity of 6061-T6: **167 W/(m\*K)**

Specific Heat of 6061-T6: **900 J/(Kg\*K)**

# Design Decisions- Mount



## 1) Minimize number of parts

- One piece of 3mm sheet metal

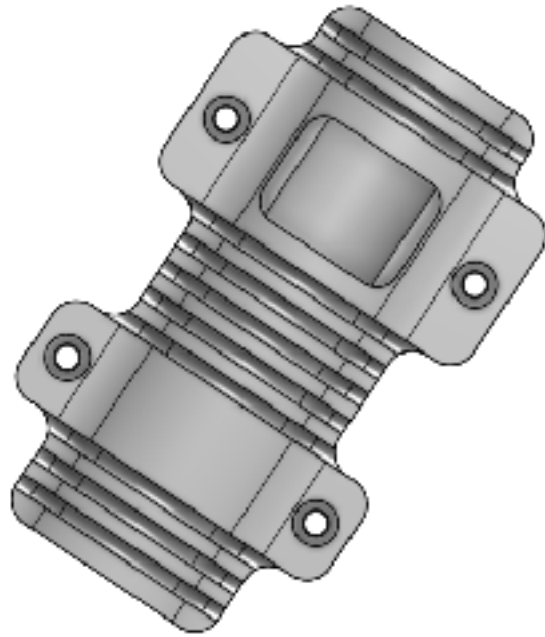
## 2) Rigid Structure

- Utilize all 3 mounting points for support

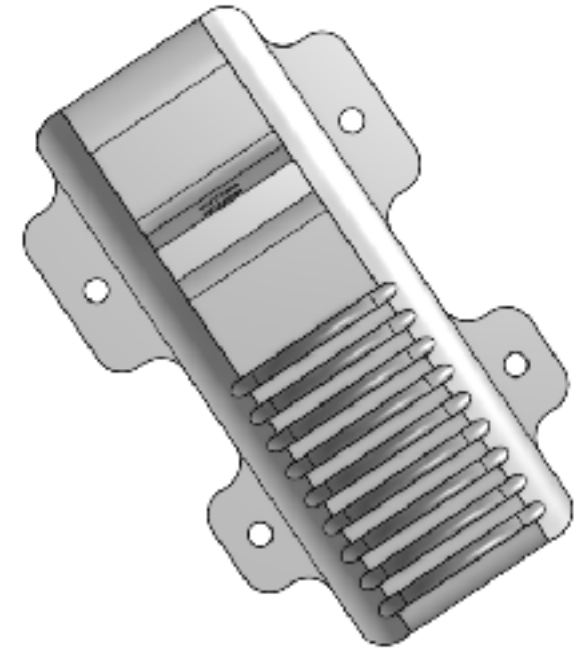
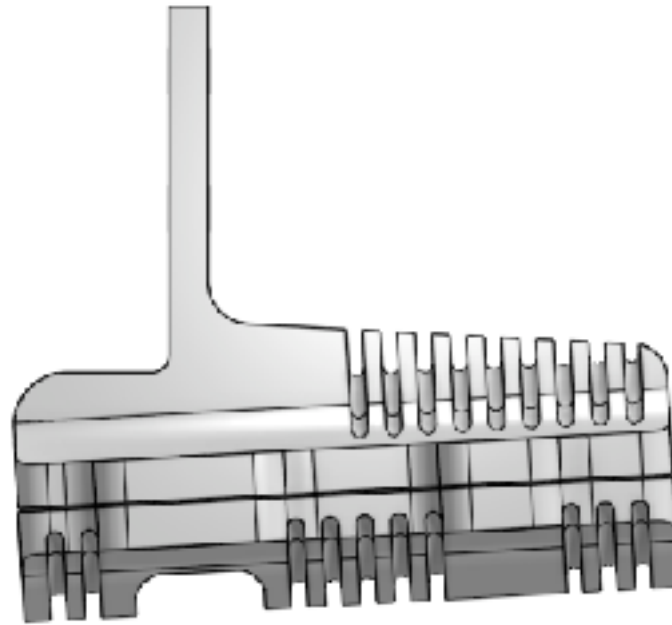
## 3) Ease of Assembly

- Screws to mounting nodes are mounted in 1 direction (from outside facing in)

# Design Decisions - Flashlight Covers



bottom half



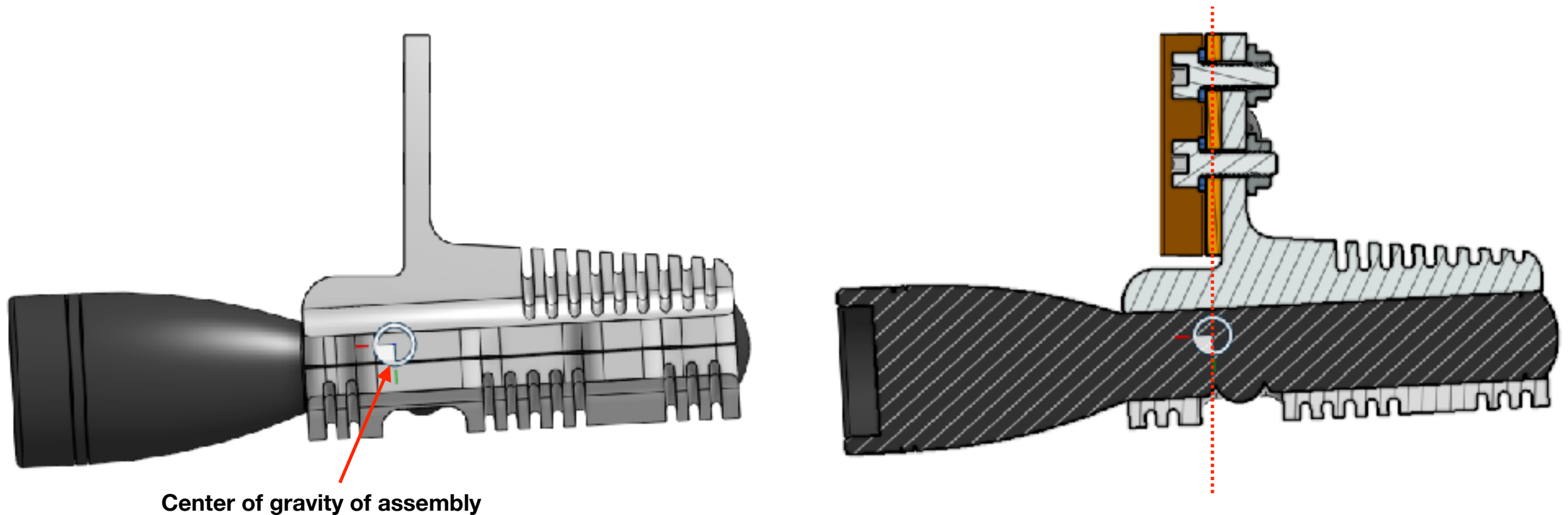
top half

**1) Minimize parts**  
- 2 halves, made using CNC machining

**2) Good cooling ability**  
- added fin structure (inspired by some flashlight designs)



# Design Decisions - Flashlight Covers



Center of gravity of assembly

**Mount flashlight + cover  
assembly with its center of  
gravity directly under center axis  
of sheet metal mount panel**

**-reduces torque on mount panel  
from flashlight assembly**



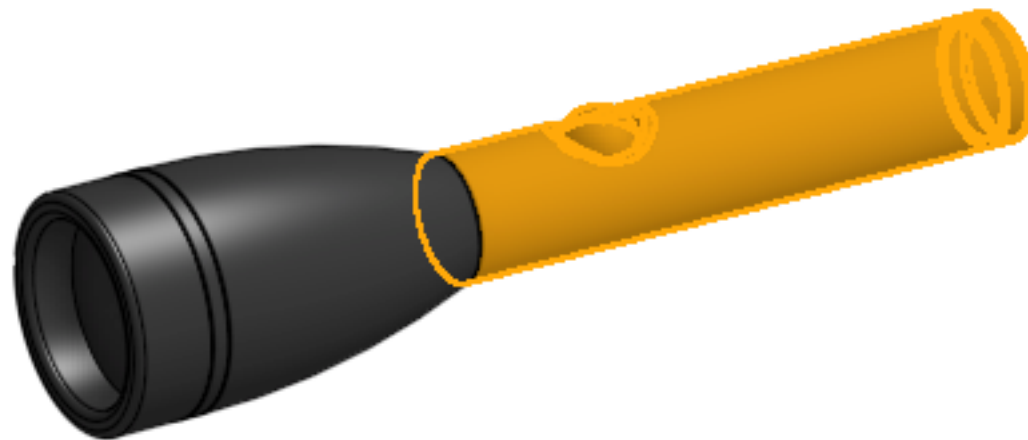
# Thermal Analysis Setup

Uniform heat distribution along flashlight handle: **30 W**

Surface heat flux on handle: **7236 W/m<sup>2</sup>**

$$4145.644 \text{ mm}^2 = 0.0041456 \text{ m}^2$$

$$30\text{W}/(0.0041456\text{m}^2) = 7236.5 \text{ W/m}^2$$



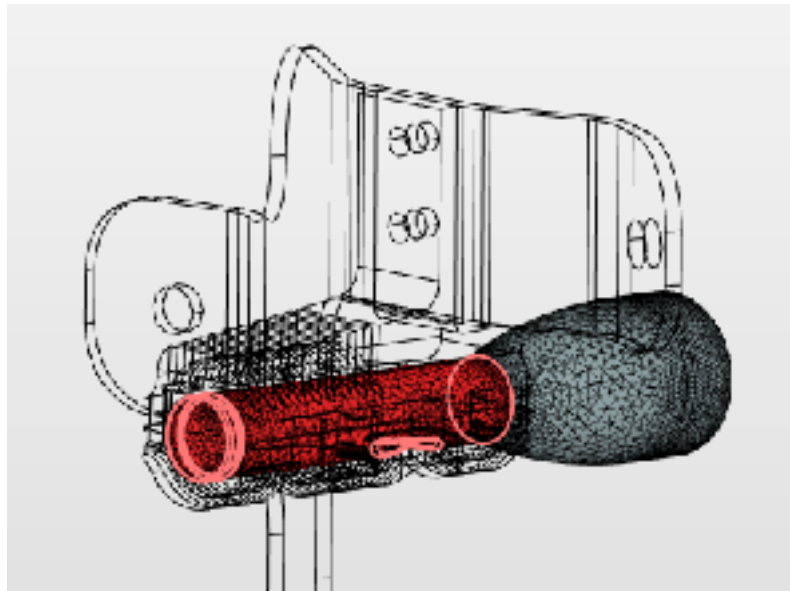
Area: **4145.644 mm<sup>2</sup>**

Reference Temperature: **293.15 K**

Convective Coefficient (natural convection of air) used: **15 W/(m<sup>2</sup>\*K)**

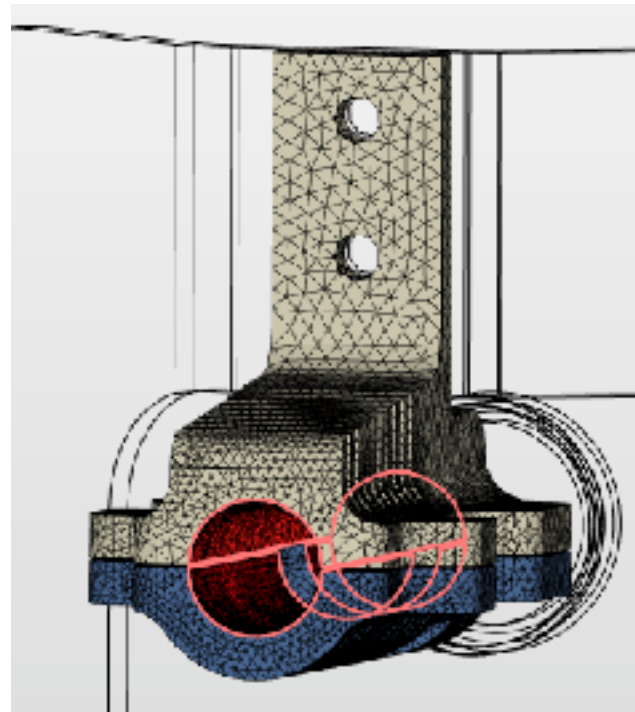


# Thermal Analysis Setup Cont.

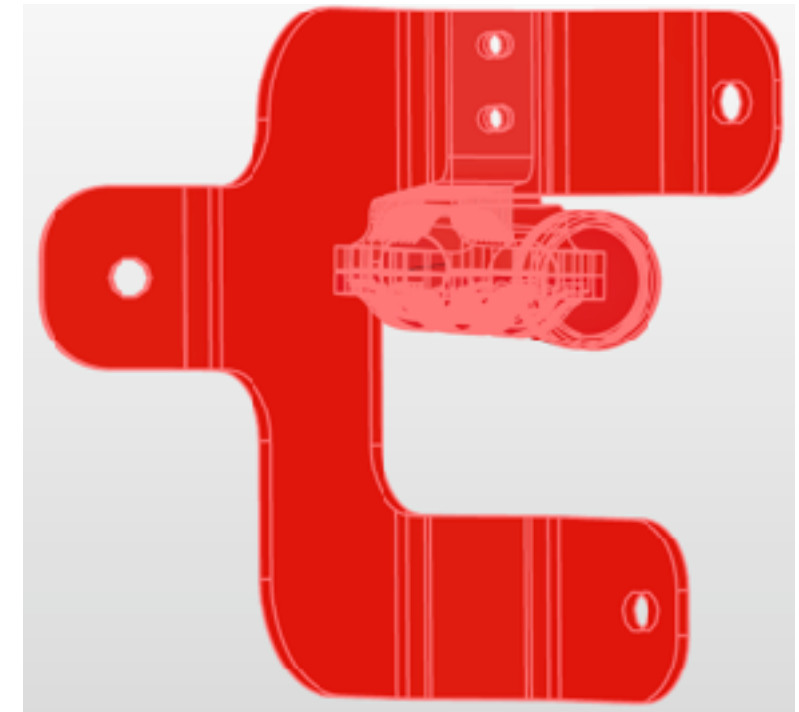


## Heated Handle

- Includes flashlight button



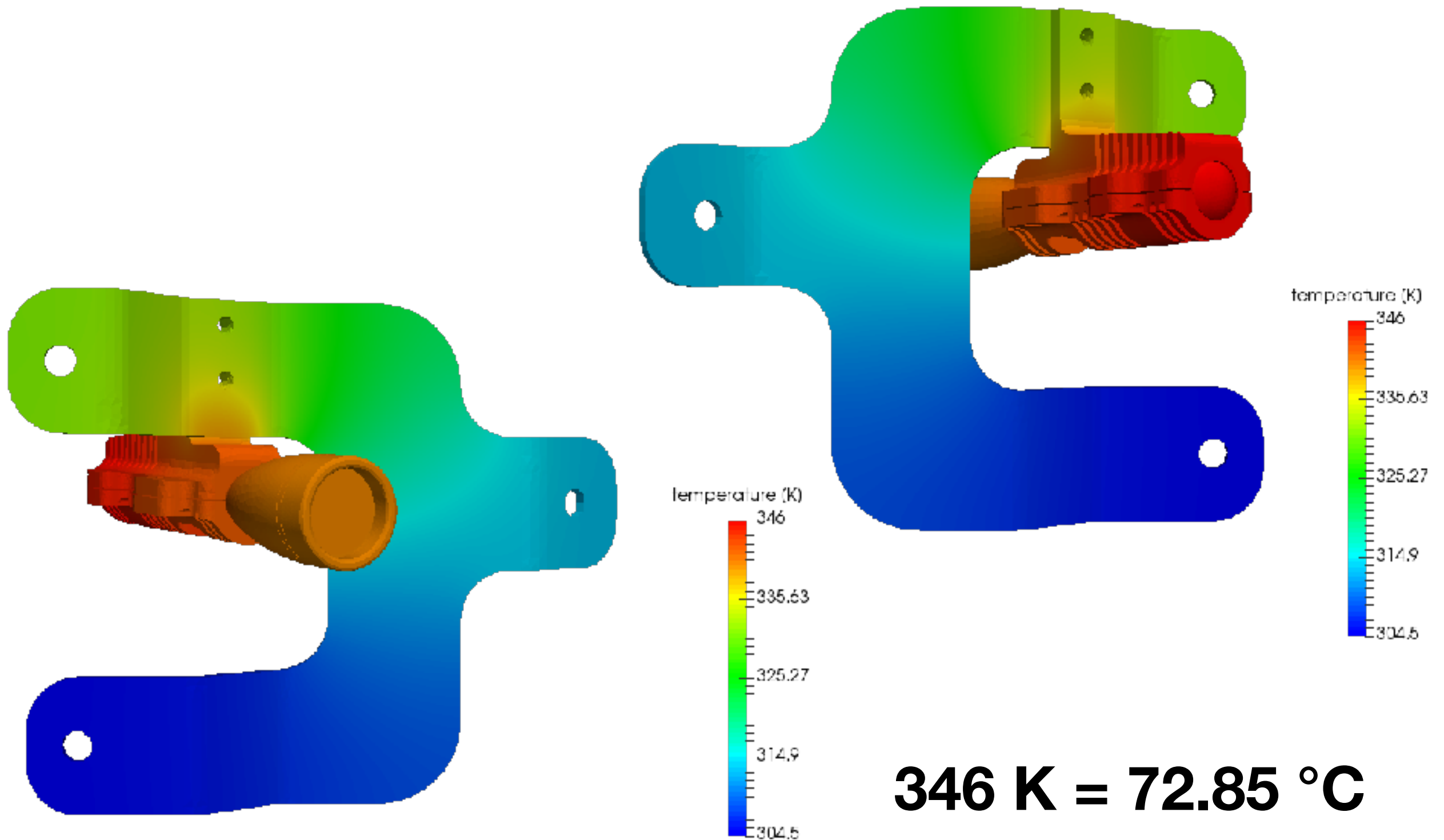
## Internal contact surfaces



## Convective surfaces

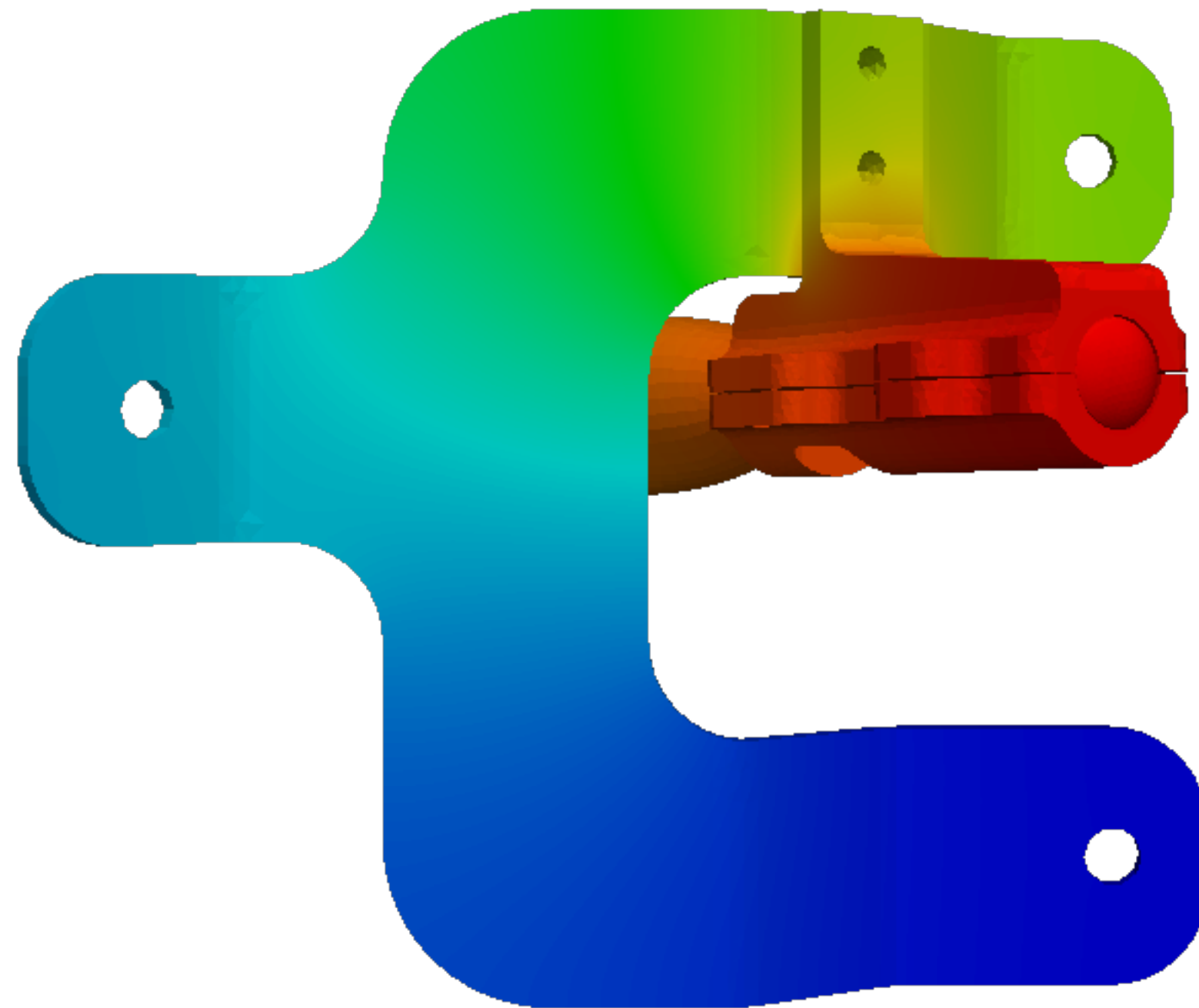
- Includes all surfaces except internal contact surfaces, covered parts of flashlight handle, flashlight lens, and contact areas between top and bottom cover halves

# Thermal Analysis Results (Simscale)



\* Under 85 °C max housing temperature

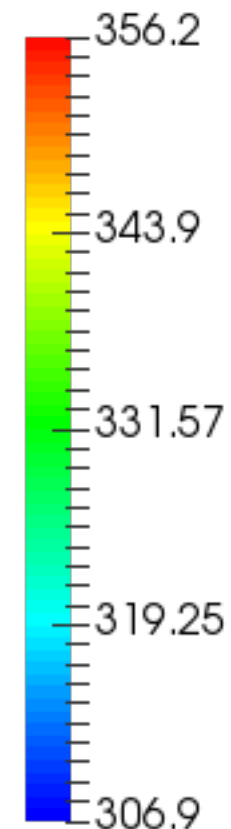
# Thermal Analysis for Comparison (No Fins)



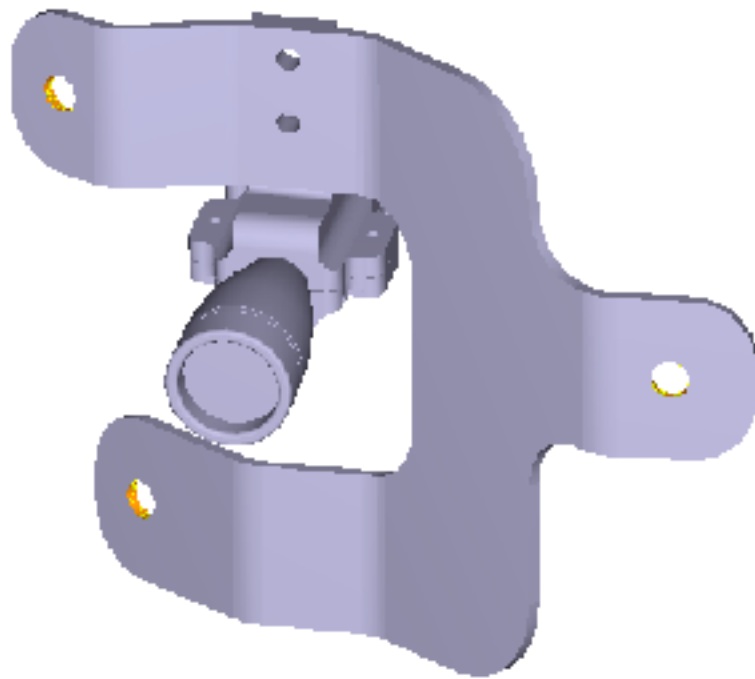
**356.2 K = 83.5 °C**

**Adding fins to structure  
reduces max  
temperature by 10.65 °C**

temperature (K)



# Modal Analysis (Simsolid)




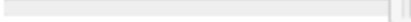
**3 constraints at mounting points**

Result

Displacement: Magnitude

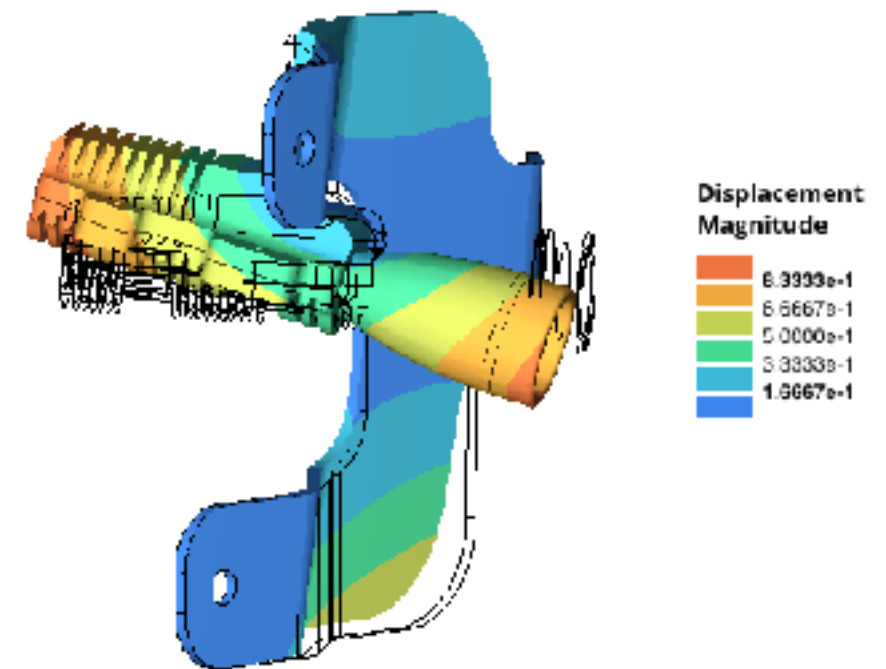
Colors: 6 12 smooth

Show deformed shape: ☒ 



#	Frequency [Hz]
1	2.2725e-2
2	3.4795e-2
3	5.3569e-2





**First Mode: ~227.2 Hz**