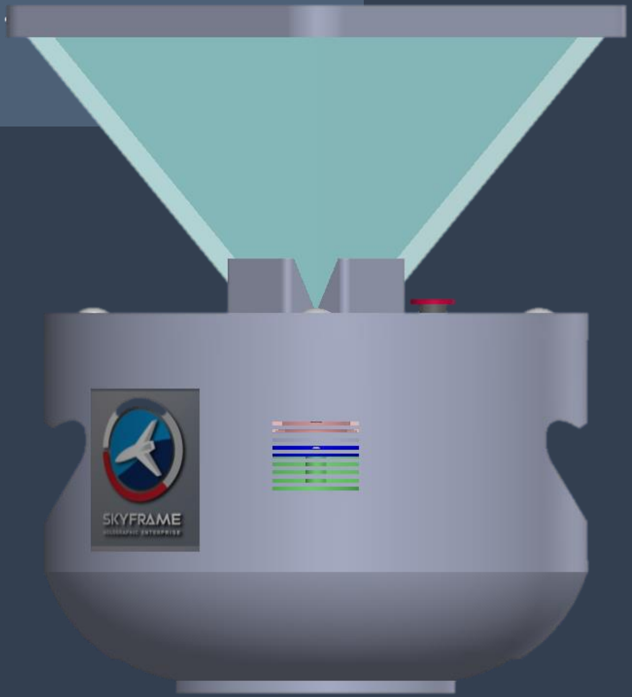
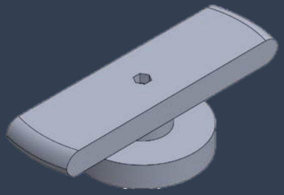
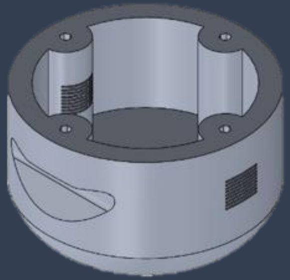
Team members :	Role
CORRE Alexandre →	*Mechanical part*
GOURBIN Léo →	*Electrical part*

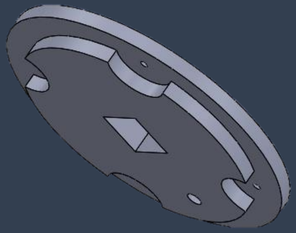
HOLOGRAM FOR AERONAUTICS

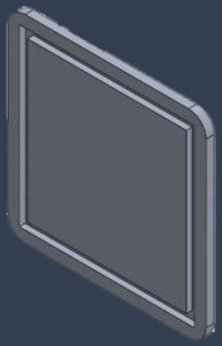


11/12/2024









SUMMARY

INTRODUCTION

We are proud to present our innovation: a revolutionary holographic module designed to replace traditional screens in airplanes.

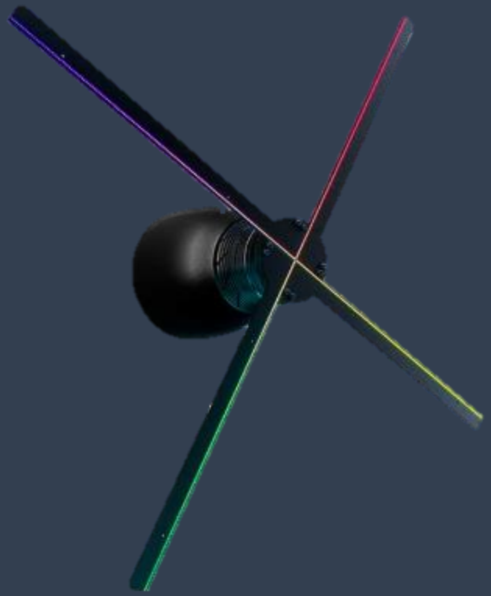
Mounted on seats, it offers an immersive and interactive experience, redefining in-flight entertainment.

PROBLEM

How can we design an innovative holographic module that can be adapted to airplane seats in both fixed and portable configurations, while adhering to a strict set of requirements including design, material selection, cost optimization, timeline management, weight constraints, mechanical resistance, and compliance with aviation standards?

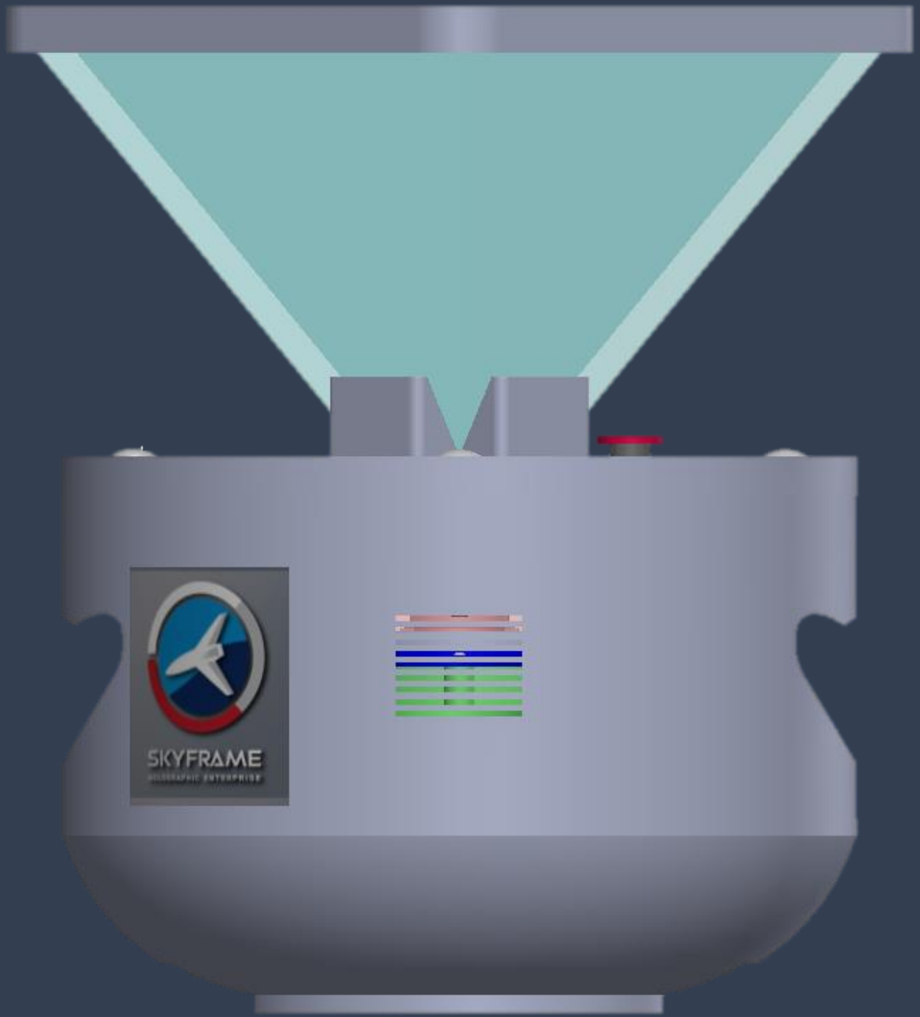
STATE OF THE ART

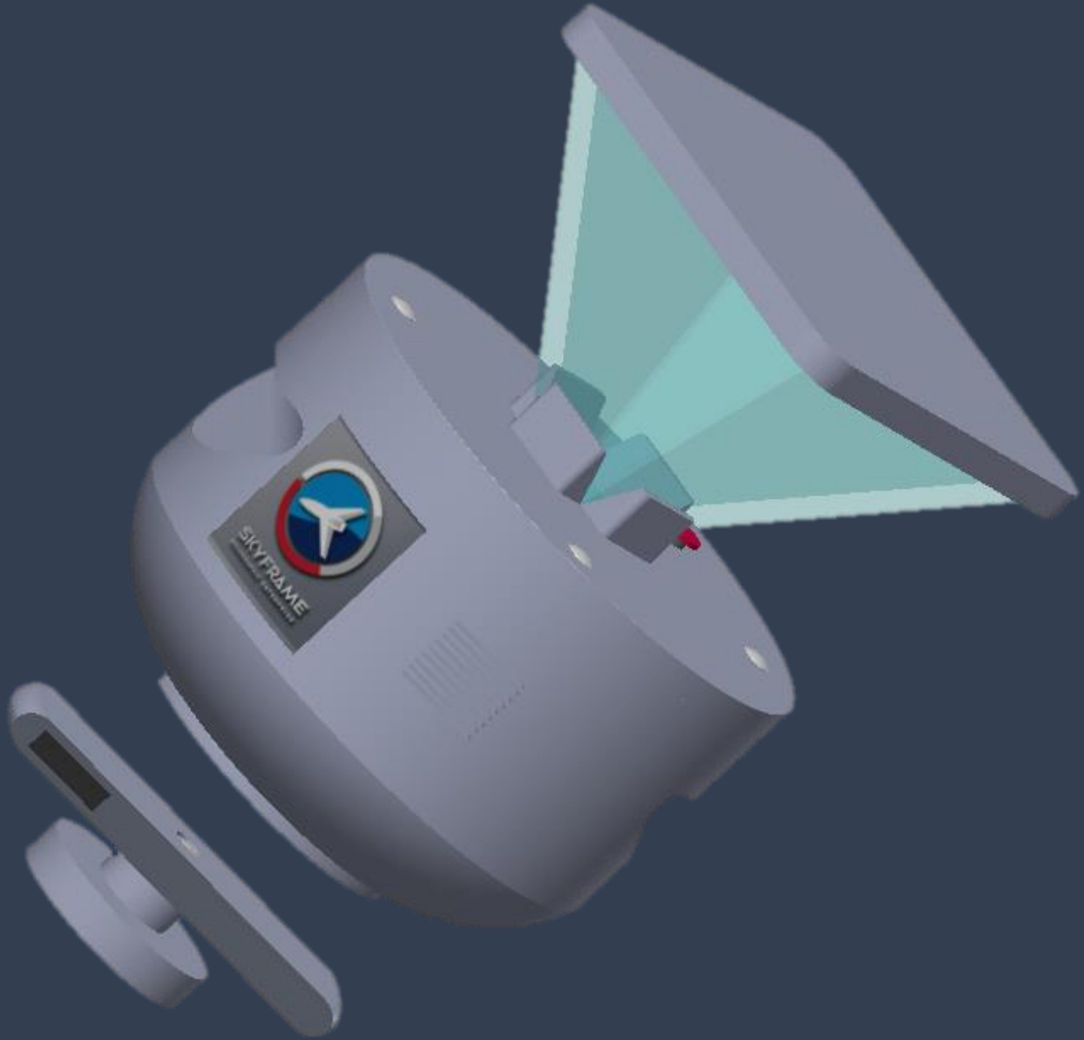
Propeller system



Projection via a screen divided into 4 parts

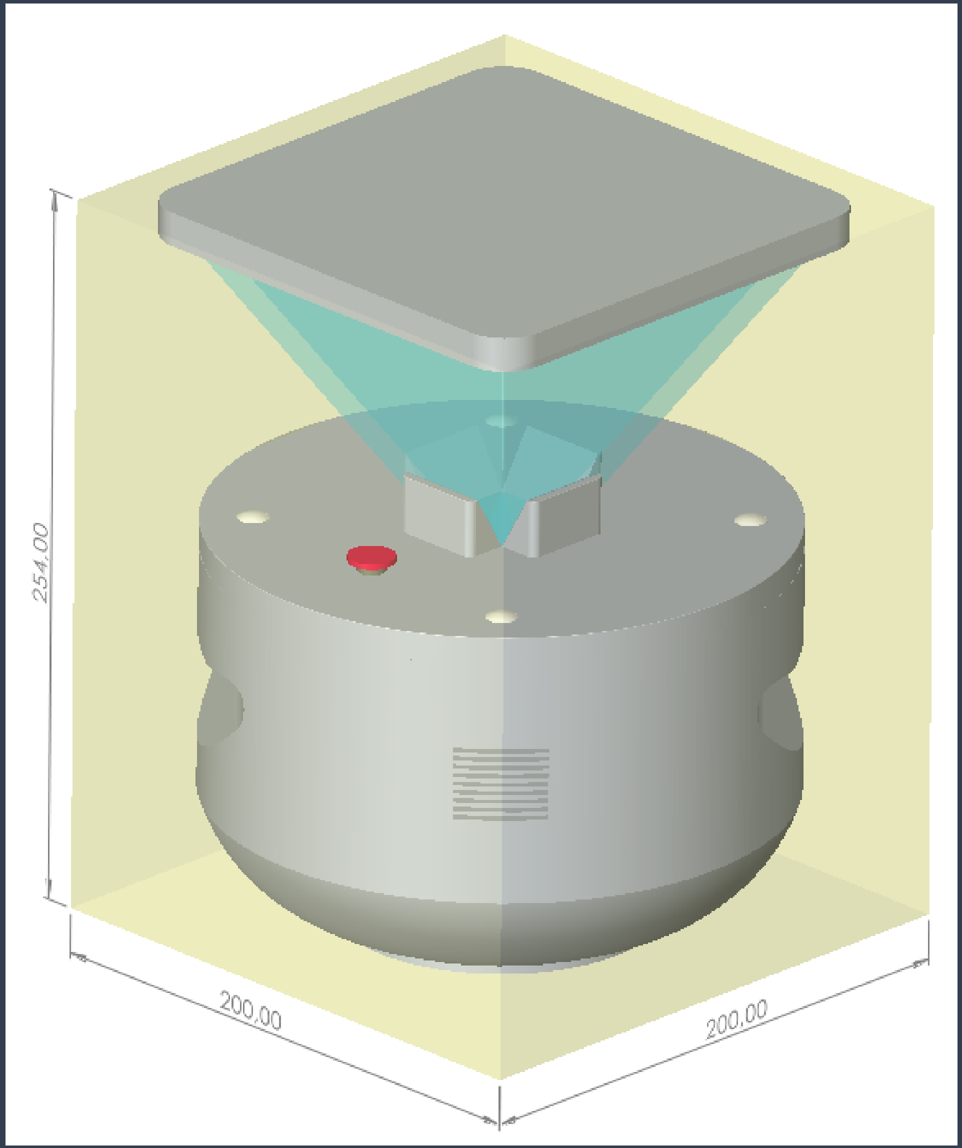
OUR SOLUTION

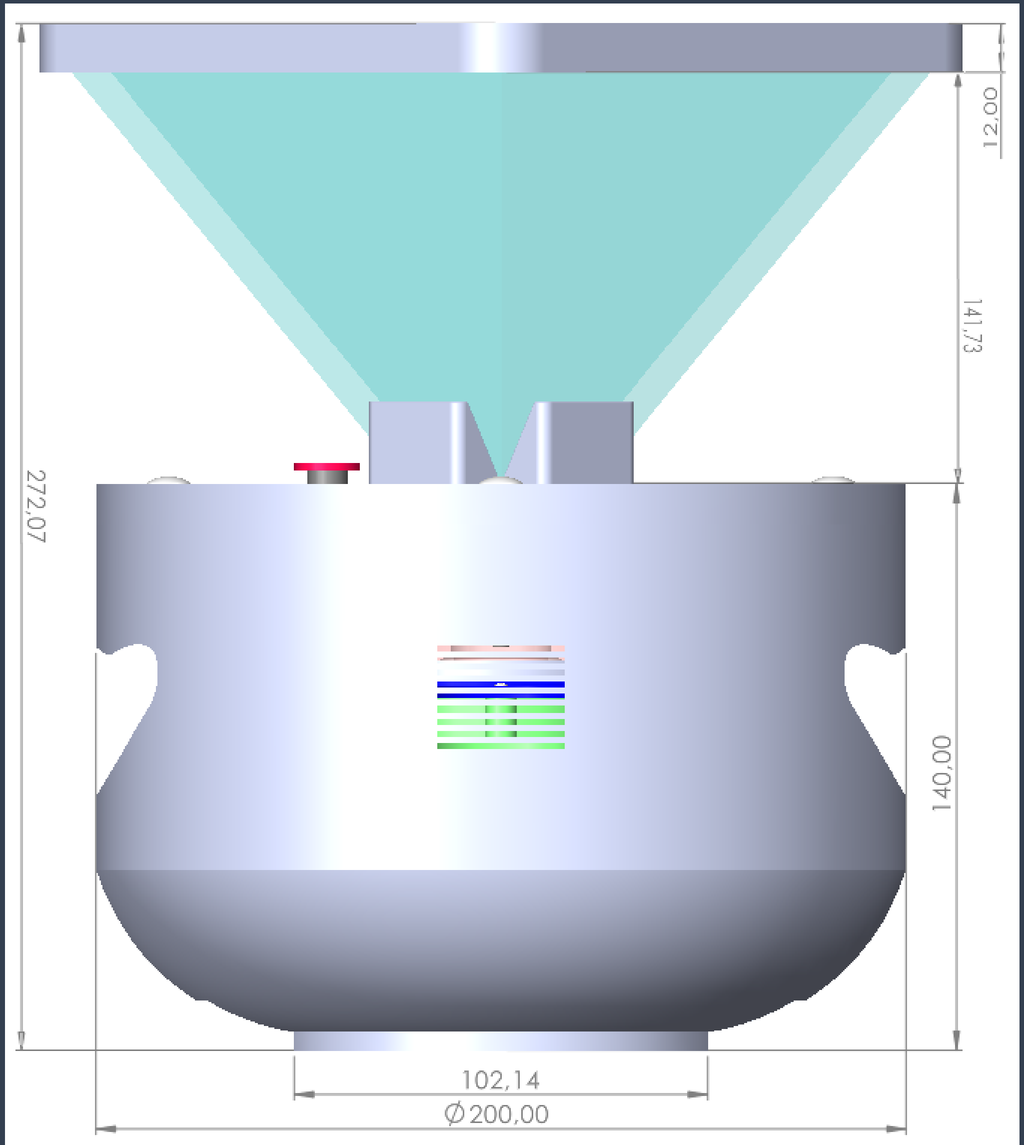




OUR SOLUTION

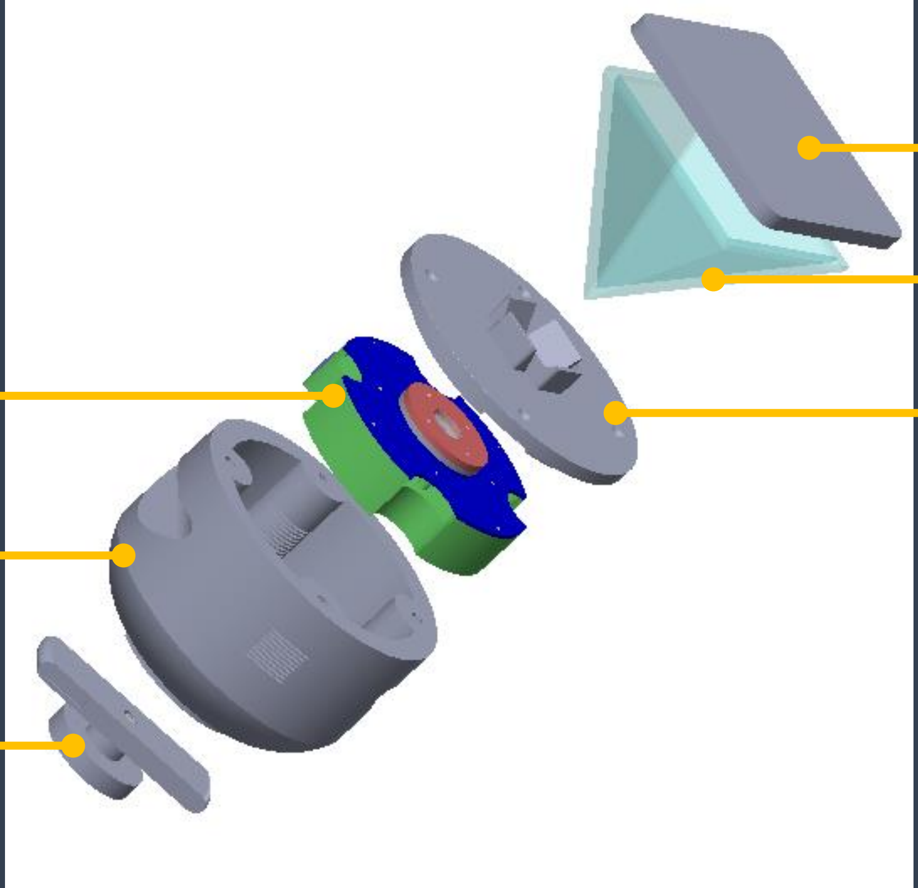
DIMENSIONS





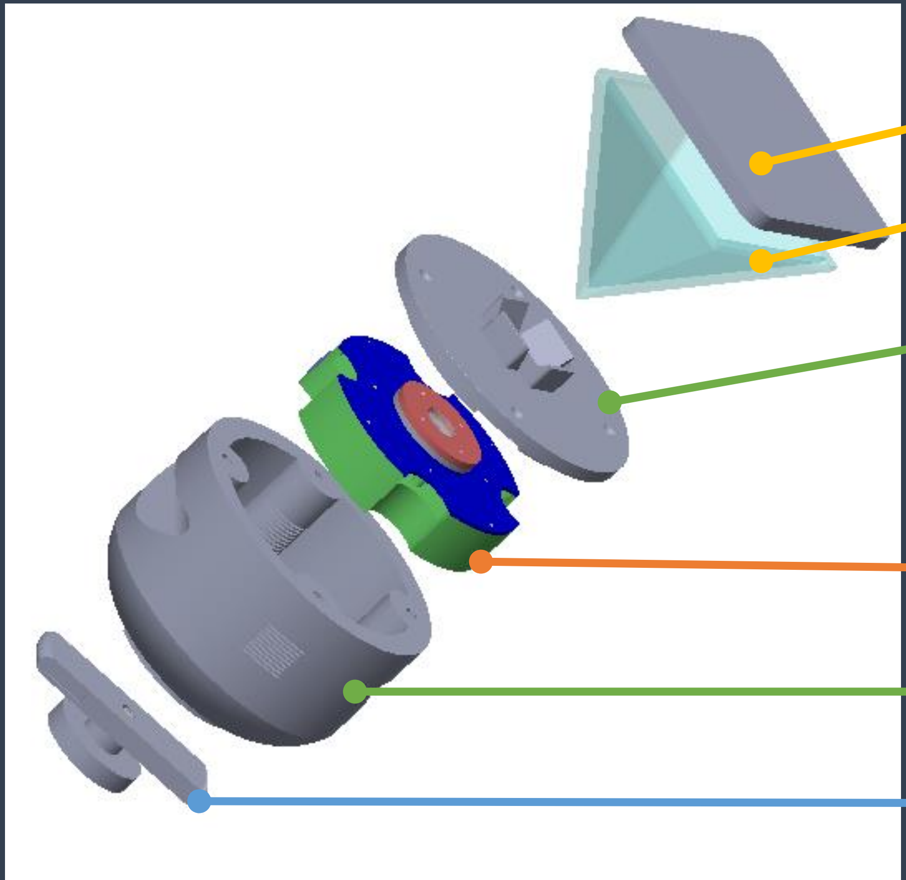
OUR SOLUTION

4 PARTS



OUR SOLUTION

DATA



Cover
300 g

Projection frame
370 g

Enclosure lid
956 g

Enclosure
3 541 g

Electronics
300 g

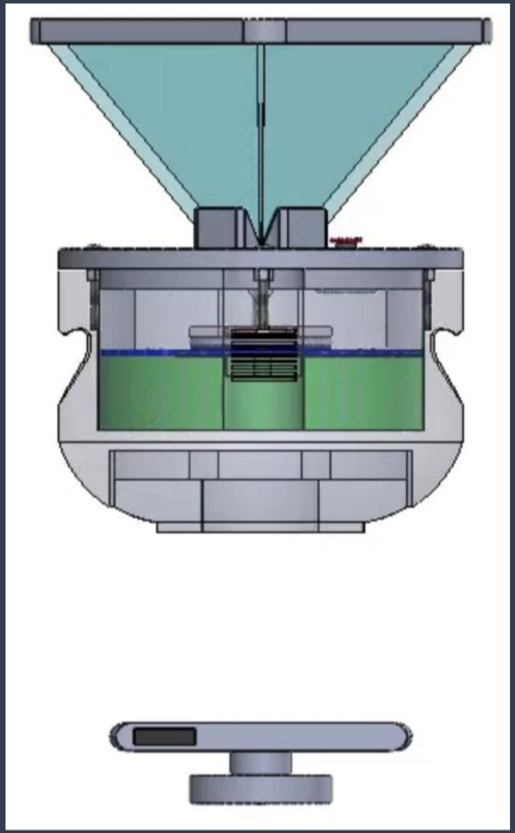
System attachment
356 g

Total mass of the system
5 823 g

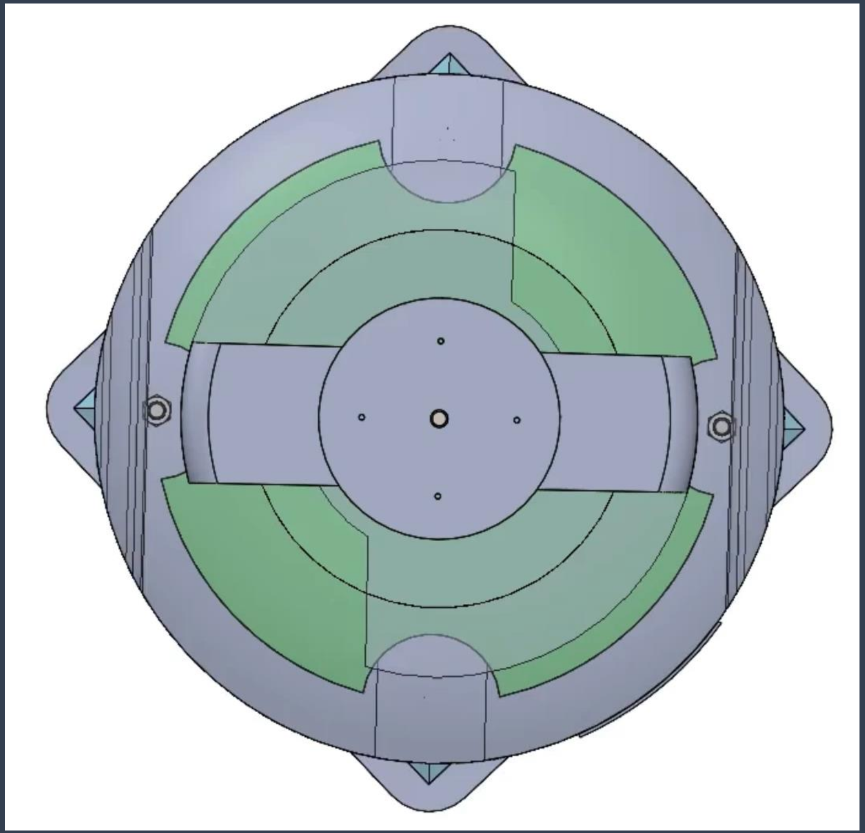
Mass of the detachable part
5 467 g

HOW IT WORKS

FIXING PART



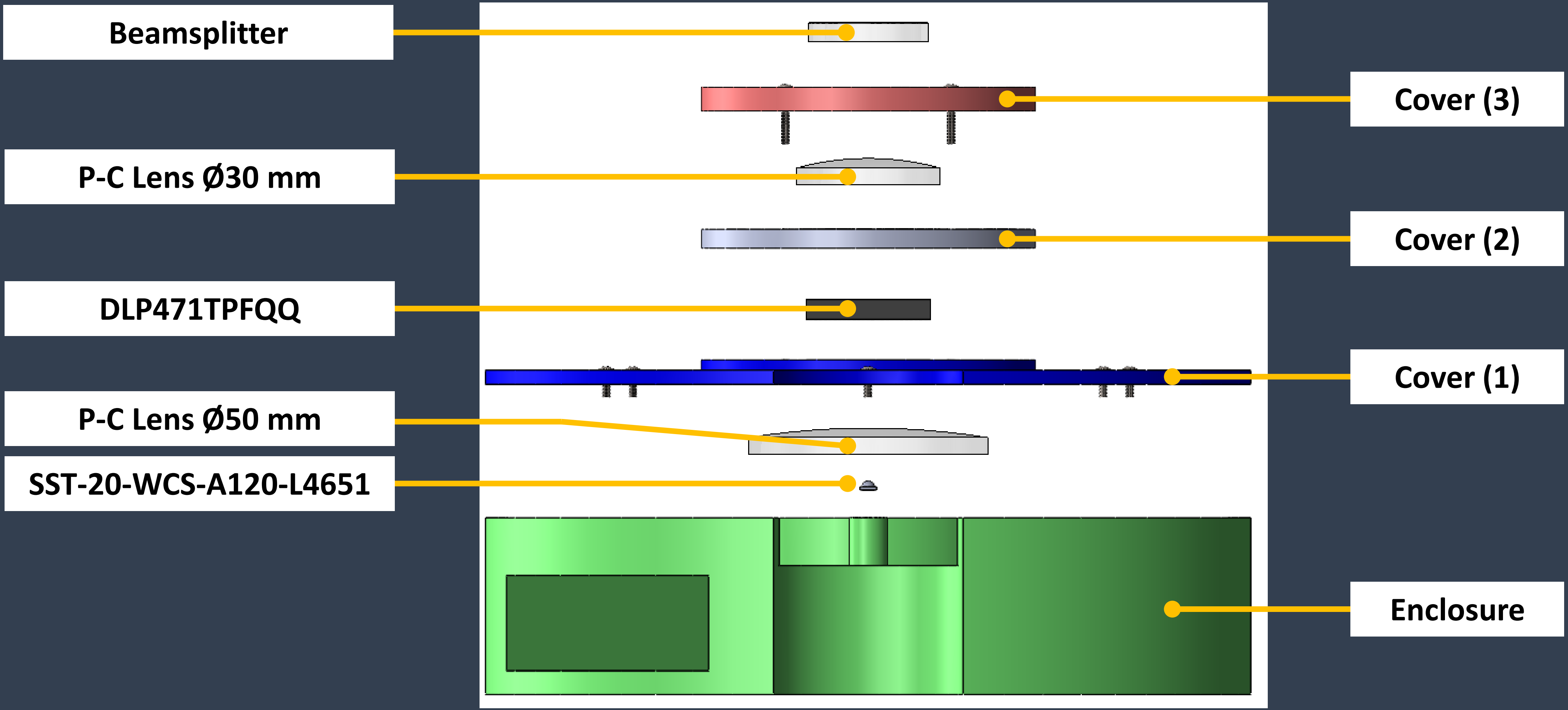
Step 01 (Placement)



Step 02 (Locking)

HOW IT WORKS

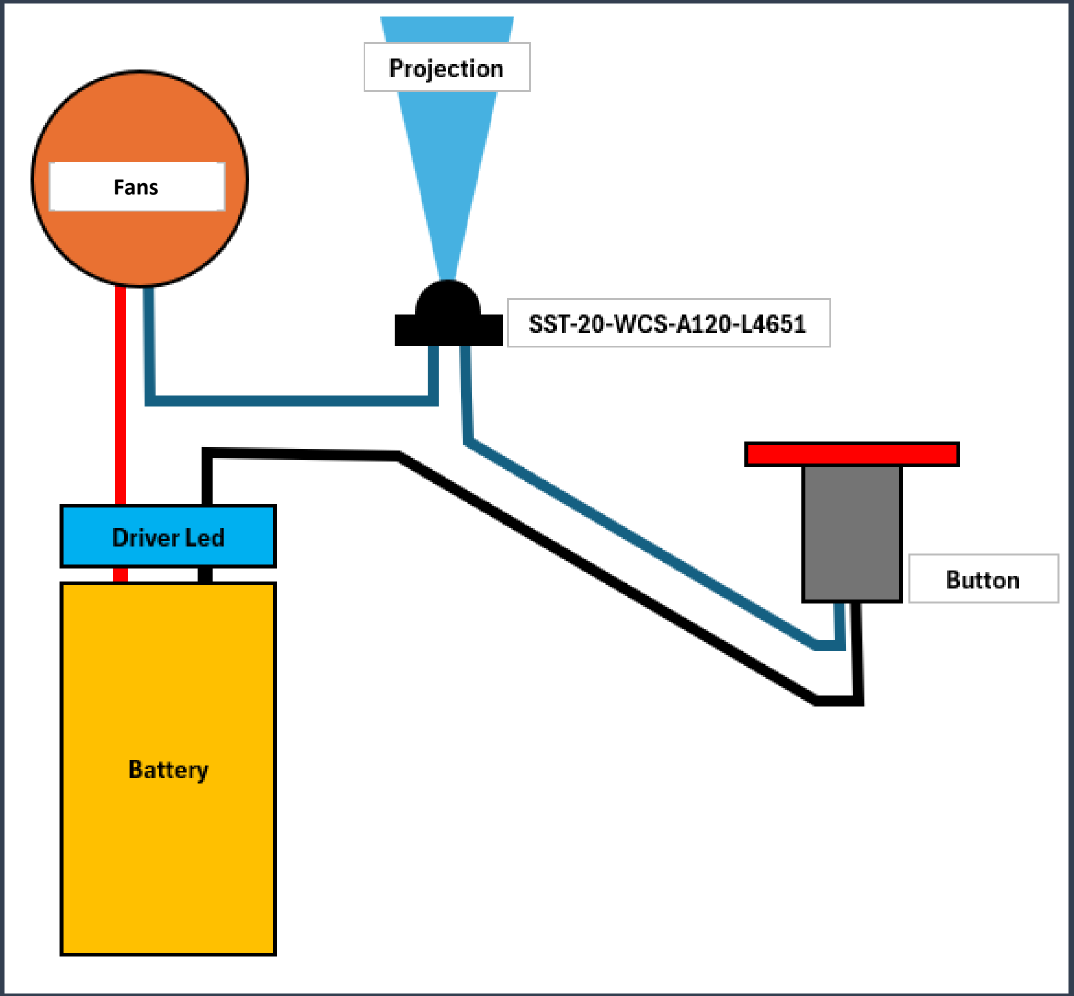
PROJECTION PART



P-C : Plano-convex

HOW IT WORKS

ELECTRICAL DIAGRAM



System reliability

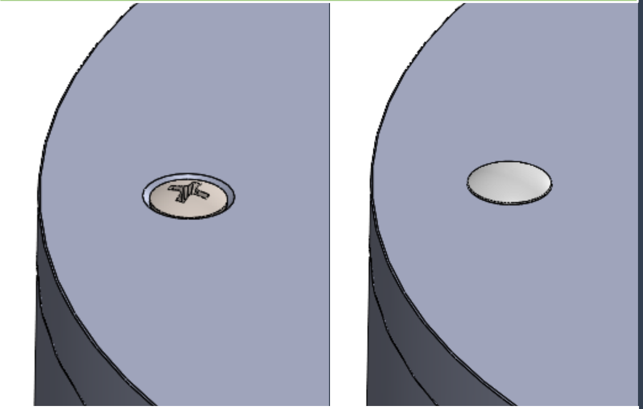
System simplicity

Ease of maintenance

HOW IT WORKS

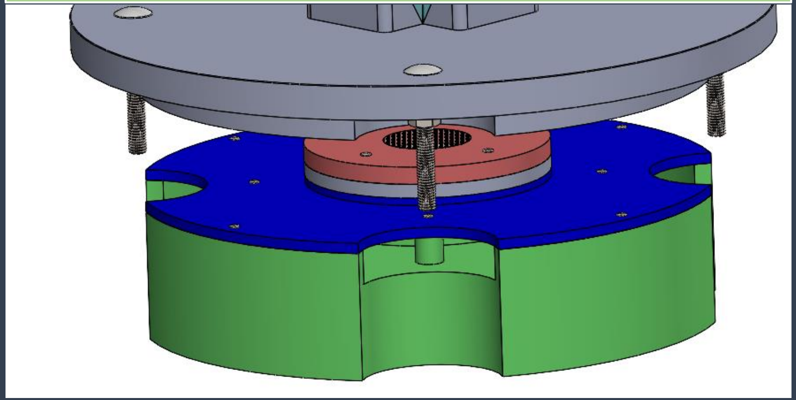
SAFETY

Screw cap



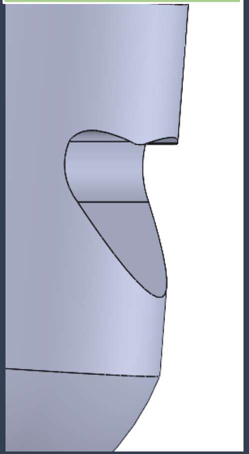
Before After

Inaccessible electronic part

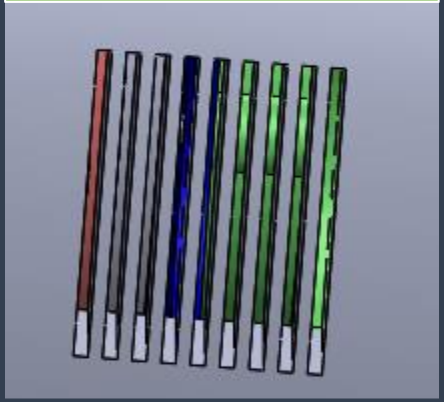


- Limits the risk of cuts
- Limits the electrical hazard
- Limits the risk of snagging
- Limits system overheating

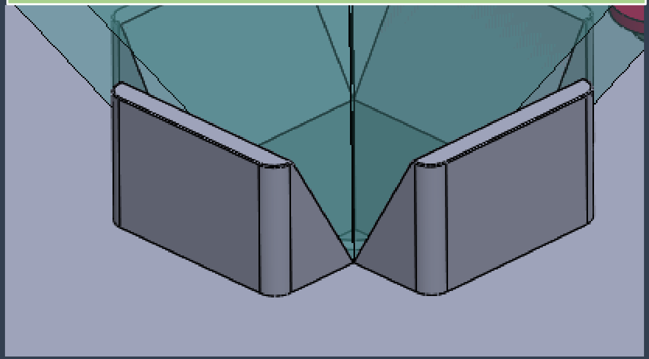
Handles for transport



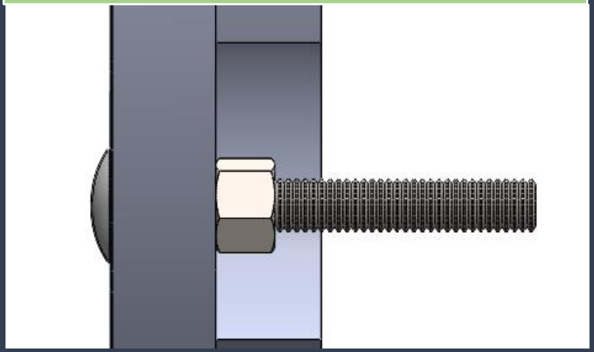
Ventilation system



Deburred edges/Chamfered

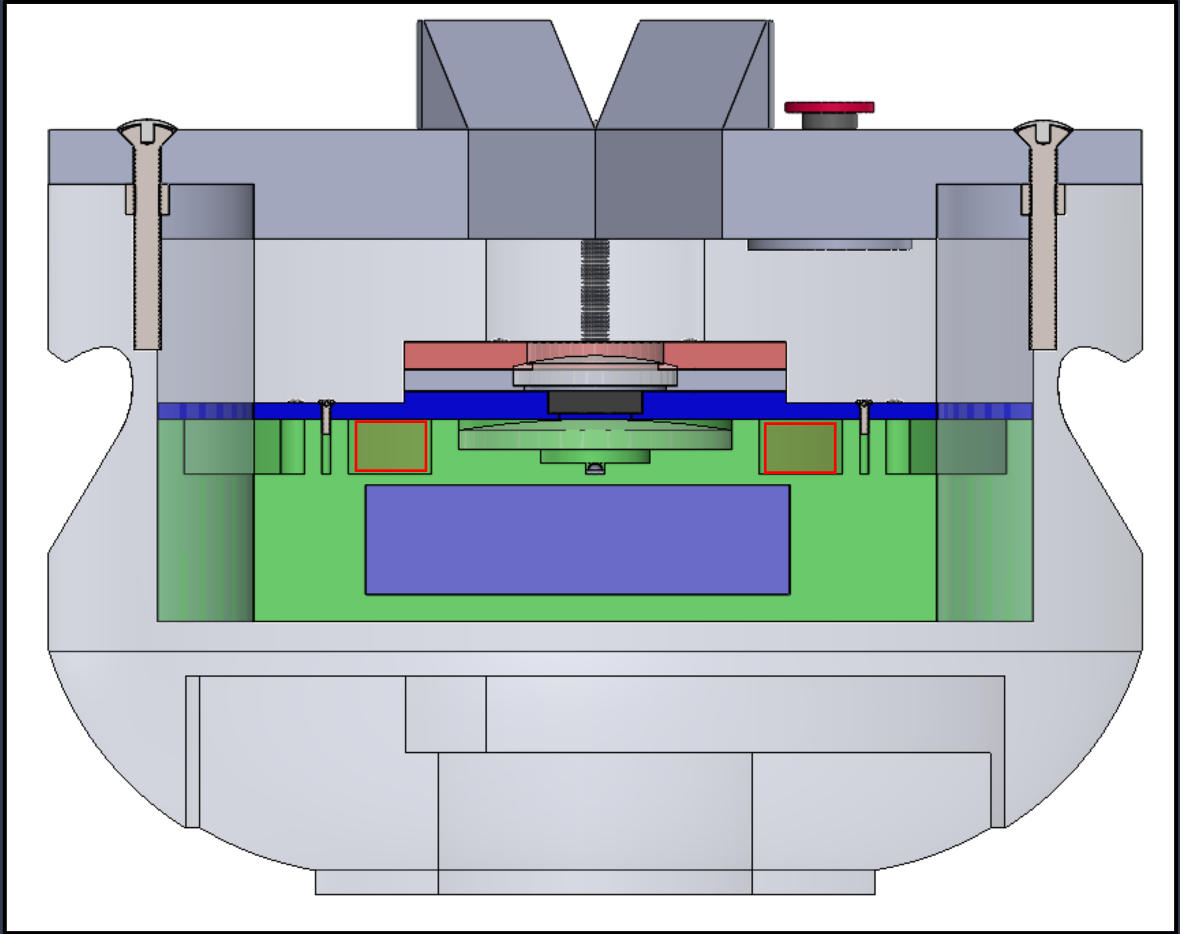


High fastening system

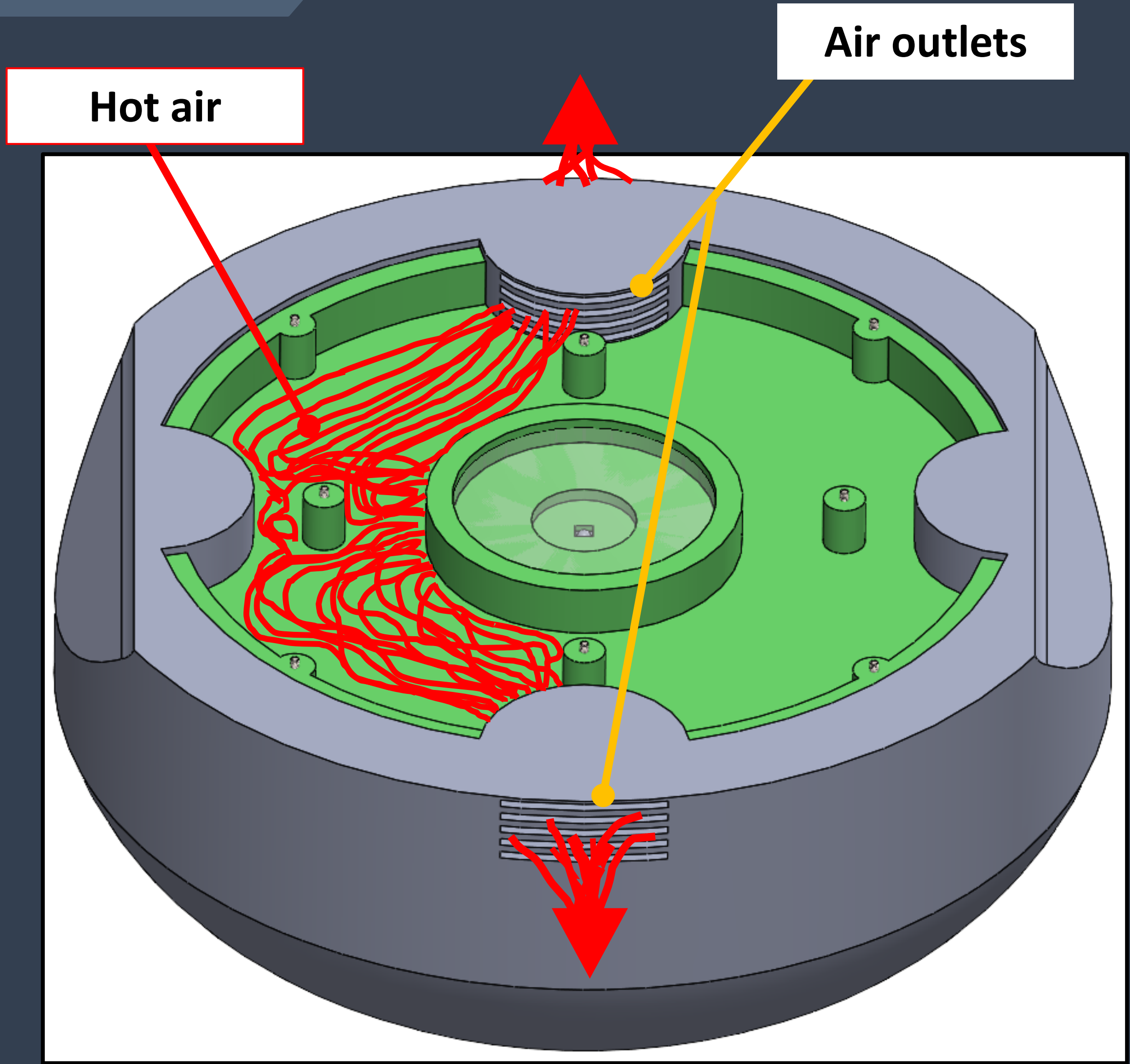


HOW IT WORKS

COOLING

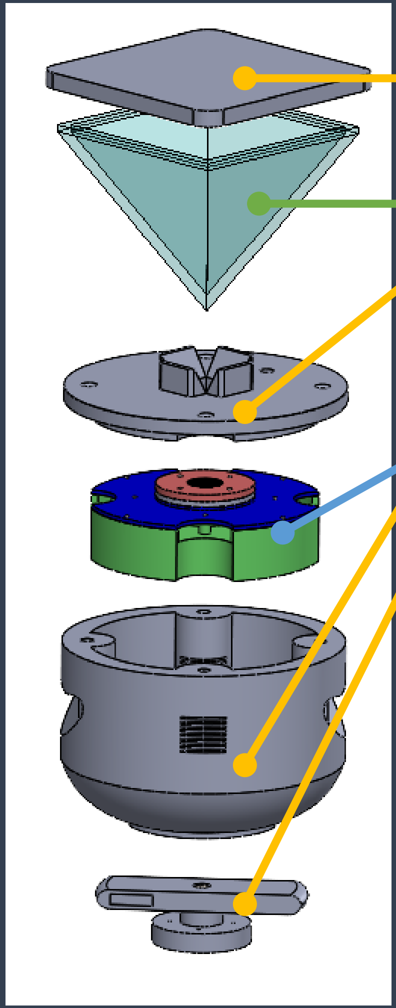


Cross-sectional view of the solution



ISO cross-sectional view of the solution

MATERIAL SELECTION



2024 aluminium alloy

PET (Plastic)

PLA (Plastic)

Information (2024 aluminium alloy)

- Good strength-to-weight ratio
- Good fatigue resistance
- Ease of machining
- Non-magnetic material
- Low environmental impact
- Available in large quantities

Information (PET)

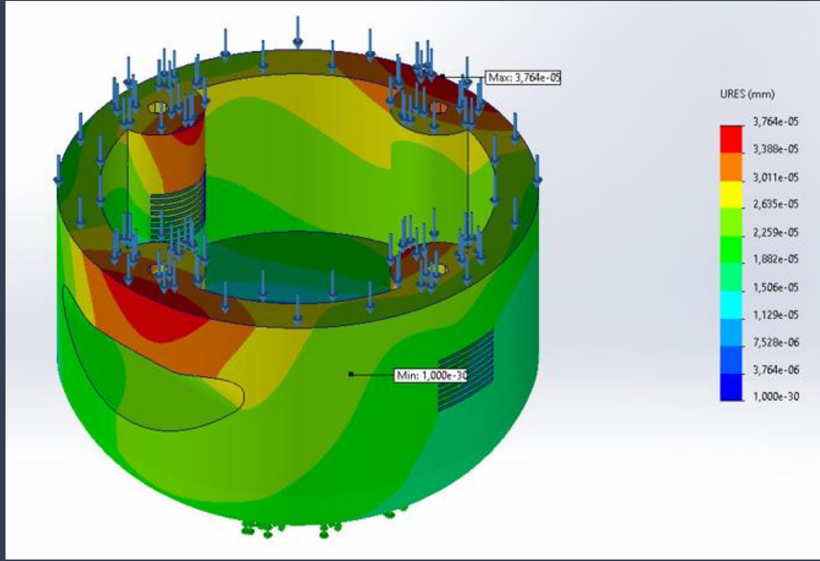
- Low weight
- Recyclable
- Low cost
- Available in large quantities

Information (PLA)

- Low weight
- Recyclable
- Low cost
- Available in large quantities

MECHANICAL ANALYSIS

MODULE BODY



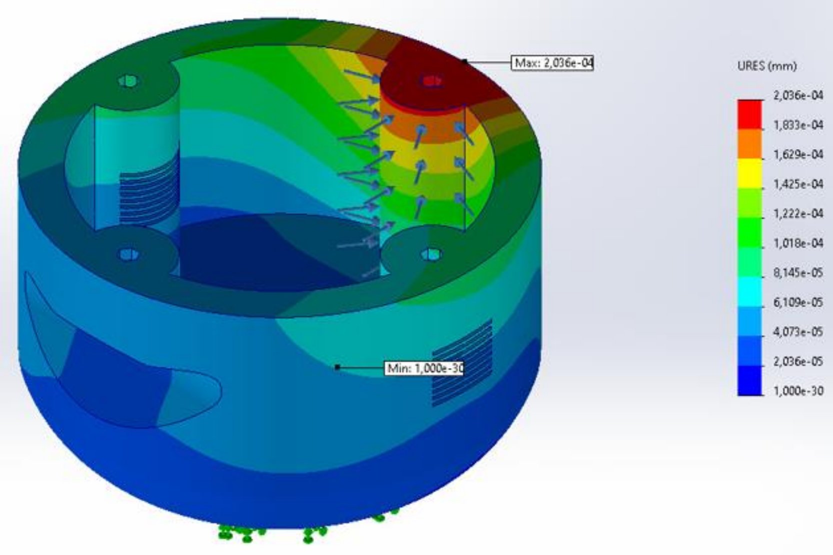
Axial Stress (σ) — *Displacement*

Minimum :
$1{,}000 \times 10^{-30}$ mm

Maximum :
$3{,}764 \times 10^{-05}$ mm

Safety factor :

> 5



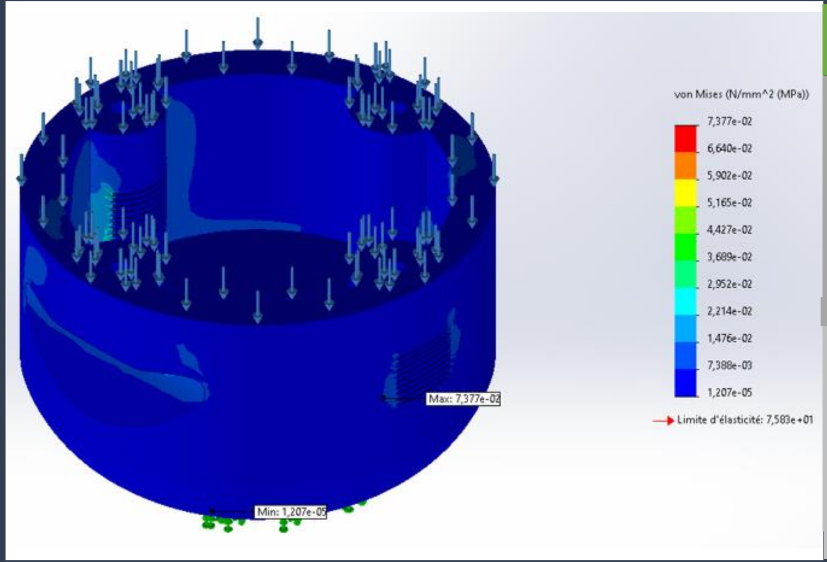
Shear Stress (τ) — *Displacement*

Minimum :
$1{,}000 \times 10^{-30}$ mm

Maximum :
$2{,}006 \times 10^{-04}$ mm

Safety factor :

> 5



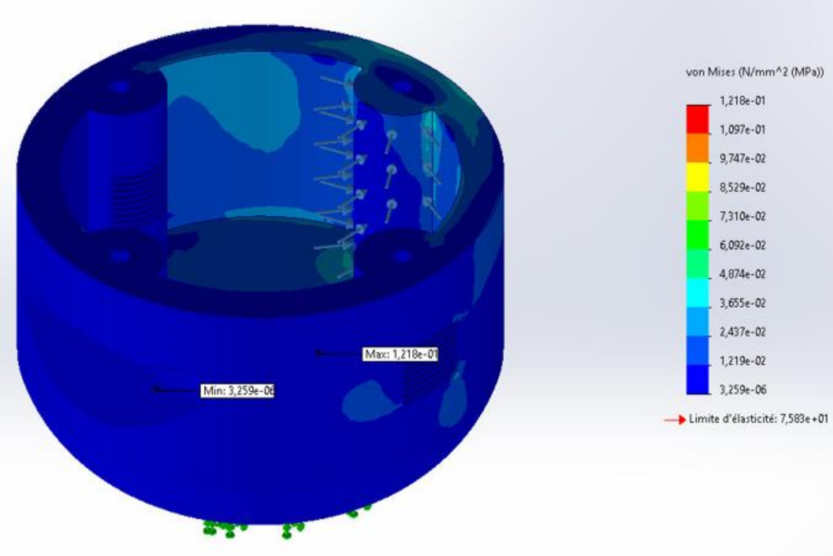
Axial Stress (σ) — *Von Mises stress*

Minimum :
$1{,}207 \times 10^{-05}$ Mpa

Maximum :
$7{,}377 \times 10^{-02}$ Mpa

Yield strength :
$7{,}583 \times 10^{+01}$ Mpa

Safety factor :
> 5



Shear Stress (τ) — *Von Mises stress*

Minimum :
$1{,}218 \times 10^{-01}$ Mpa

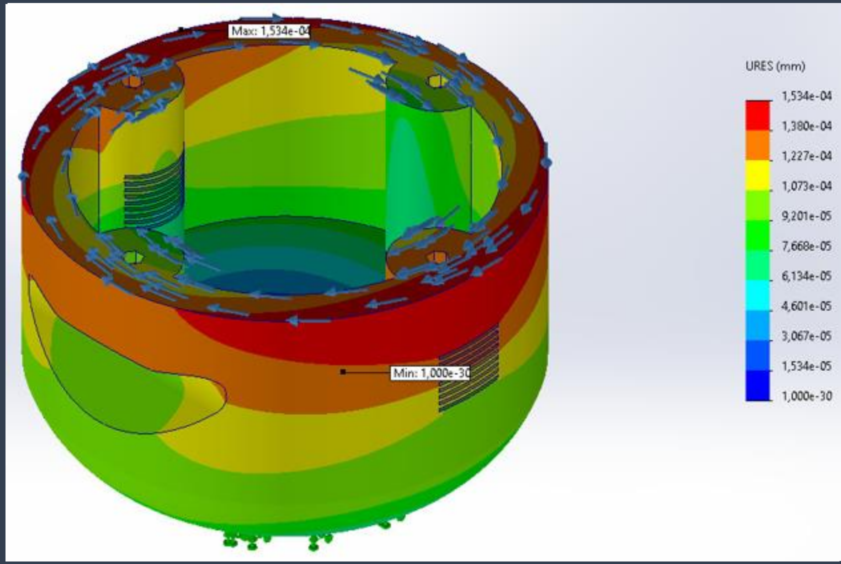
Maximum :
$3{,}259 \times 10^{-06}$ Mpa

Yield strength :
$7{,}583 \times 10^{+01}$ Mpa

Safety factor :
> 5

MECHANICAL ANALYSIS

MODULE BODY



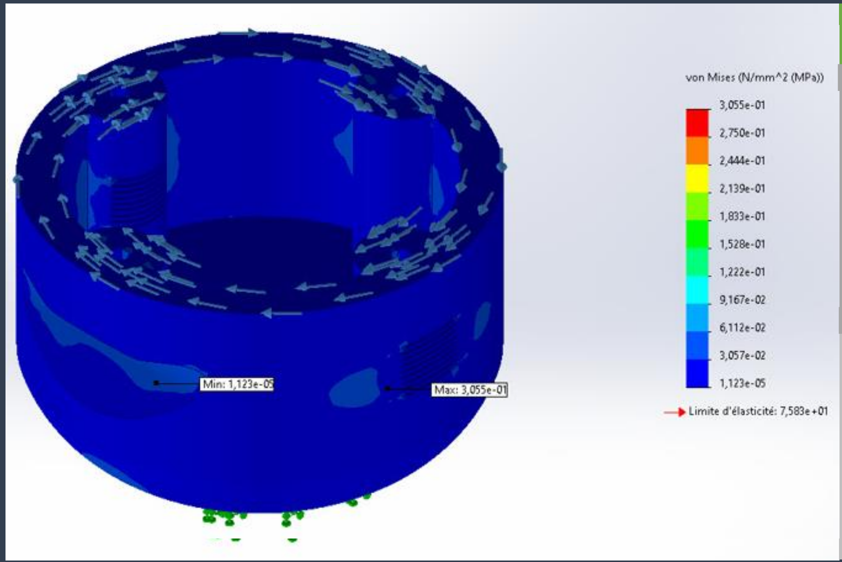
Torsional Stress (τ) — *Displacement*

Minimum :
$1{,}000 \times 10^{-30}$ mm

Maximum :
$1{,}534 \times 10^{-04}$ mm

Safety factor :

> 5



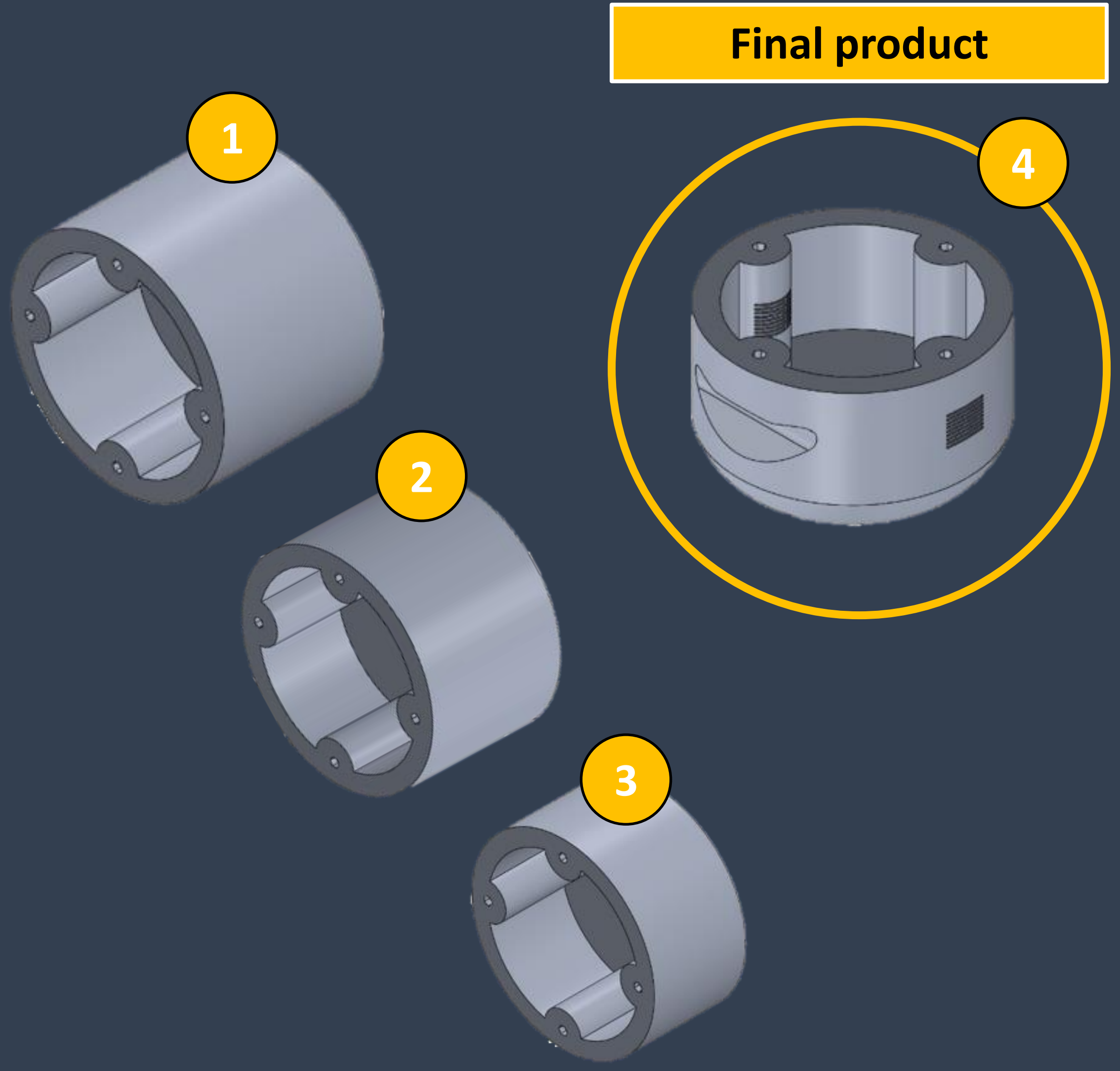
Torsional Stress (τ) — *Von Mises stress*

Minimum :
$1{,}123 \times 10^{-05}$ Mpa

Maximum :
$3{,}055 \times 10^{-01}$ Mpa

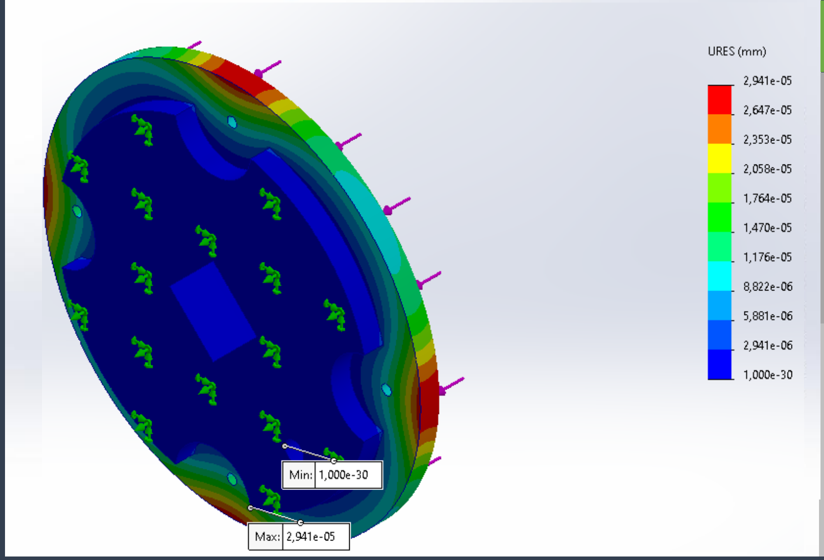
Yield strength :
$7{,}583 \times 10^{+01}$ Mpa

Safety factor :
> 5



MECHANICAL ANALYSIS

BODY COVER



Axial Stress (σ)

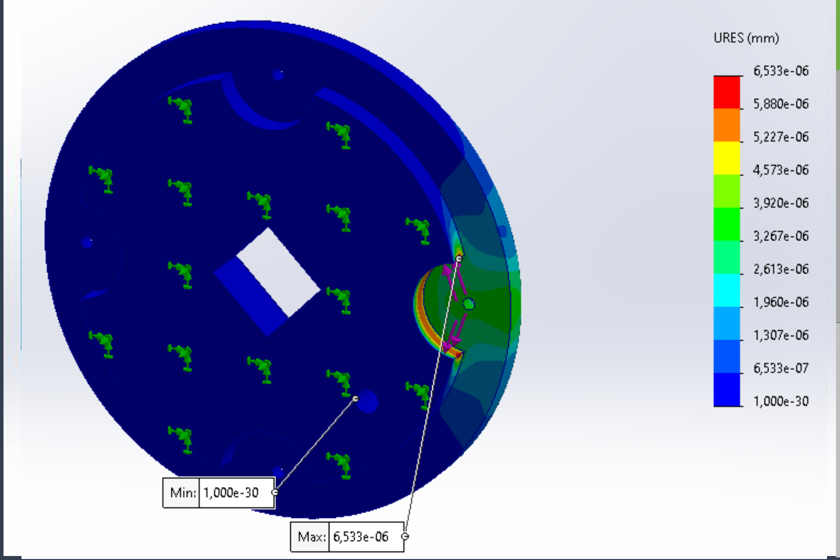
Displacement

Minimum :
$1{,}000 \times 10^{-30}$ mm

Maximum :
$2{,}941 \times 10^{-05}$ mm

Safety factor :

> 5



Shear Stress (τ)

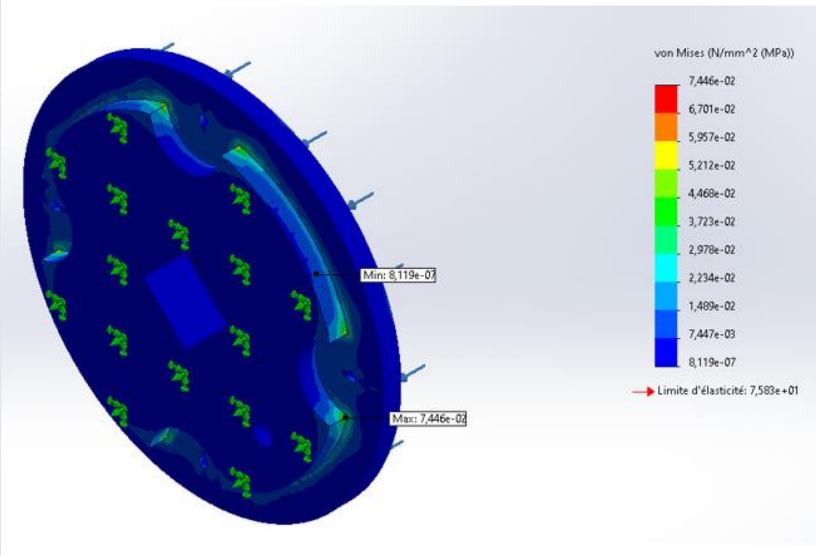
Displacement

Minimum :
$1{,}000 \times 10^{-30}$ mm

Maximum :
$6{,}533 \times 10^{-06}$ mm

Safety factor :

> 5



Axial Stress (σ)

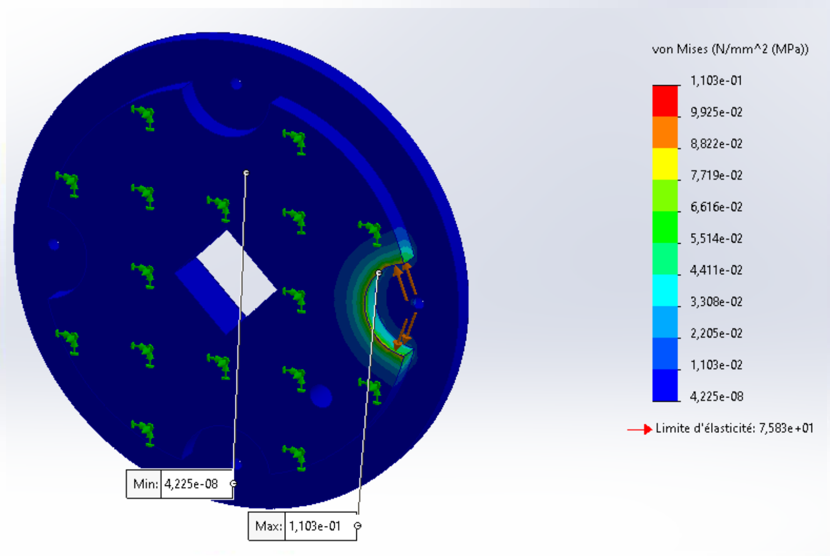
Von Mises stress

Minimum :
$8{,}119 \times 10^{-07}$ Mpa

Maximum :
$7{,}446 \times 10^{-02}$ Mpa

Yield strength:
$7{,}583 \times 10^{+01}$ Mpa

Safety factor :
> 5



Shear Stress (τ)

Von Mises stress

Minimum :
$4{,}225 \times 10^{-08}$ Mpa

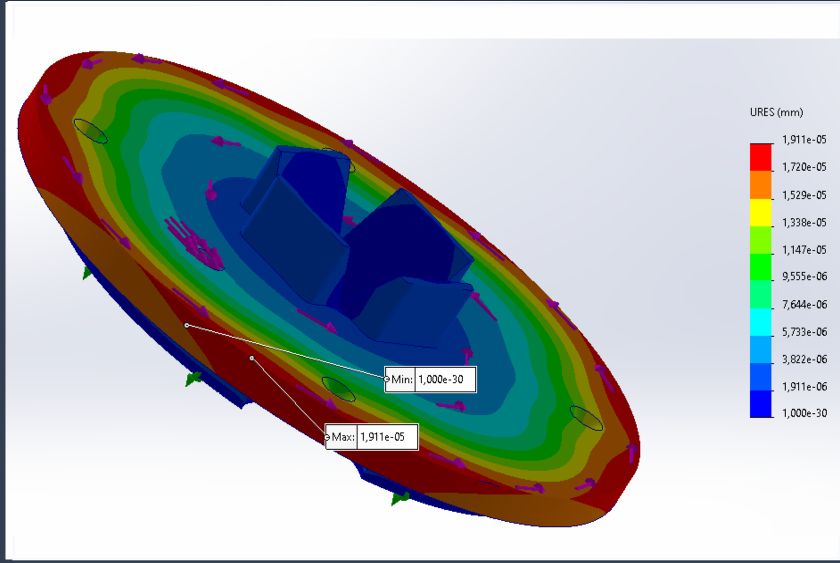
Maximum :
$1{,}103 \times 10^{-01}$ Mpa

Yield strength:
$7{,}583 \times 10^{+01}$ Mpa

Safety factor:
> 5

MECHANICAL ANALYSIS

BODY COVER



Torsional Stress (τ)

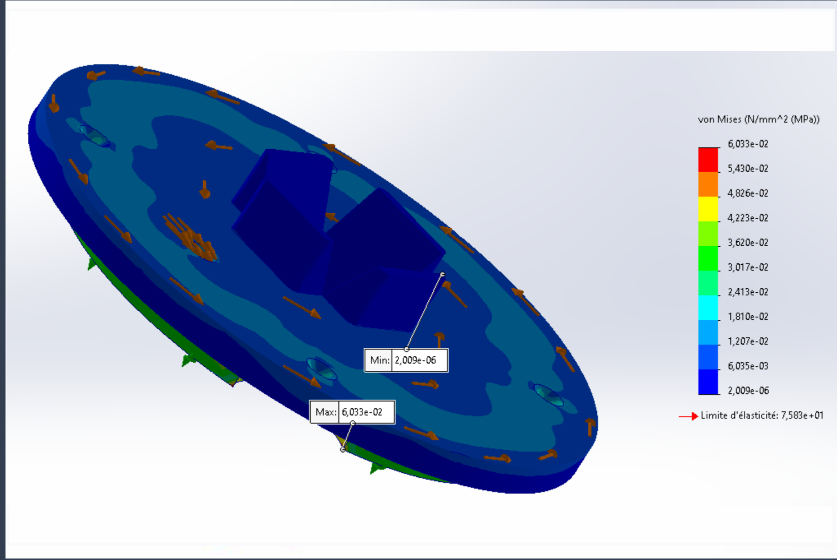
Displacement

Minimum :
$1{,}000 \times 10^{-30}$ mm

Maximum :
$1{,}911 \times 10^{-05}$ mm

Safety factor :

> 5



Torsional Stress (τ)

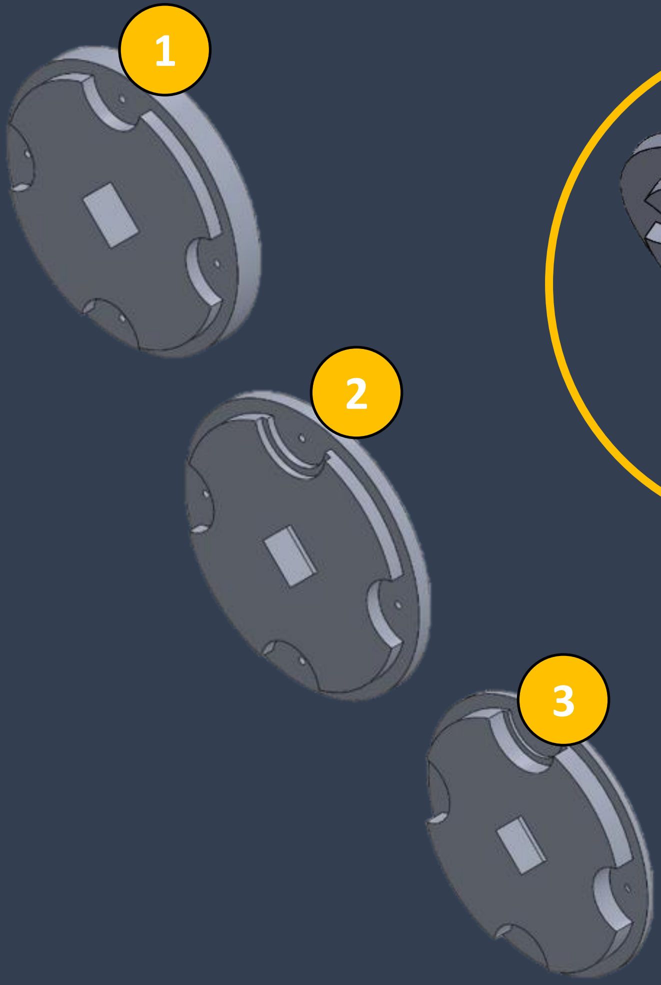
Von Mises stress

Minimum :
$2{,}009 \times 10^{-06}$ Mpa

Maximum :
$6{,}033 \times 10^{-02}$ Mpa

Yield strength :
$7{,}583 \times 10^{+01}$ Mpa

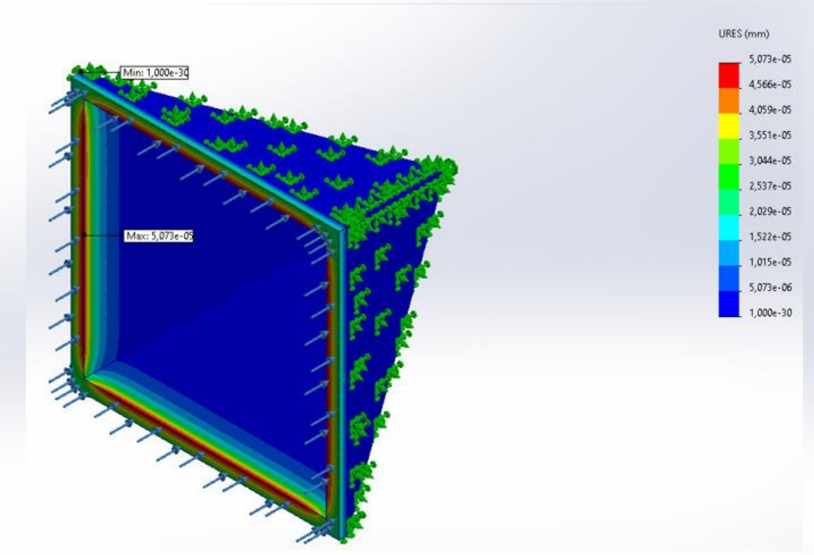
Safety factor :
> 5



Final product

MECHANICAL ANALYSIS

PROJECTION SCREEN



Axial Stress (σ)

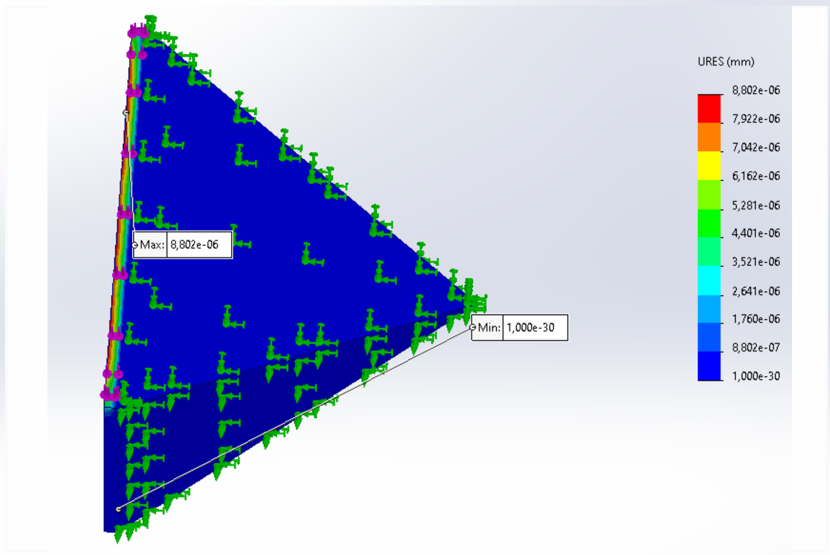
Displacement

Minimum :
$1{,}000 \times 10^{-30}$ mm

Maximum :
$5{,}073 \times 10^{-05}$ mm

Safety factor :

> 5



Shear Stress (τ)

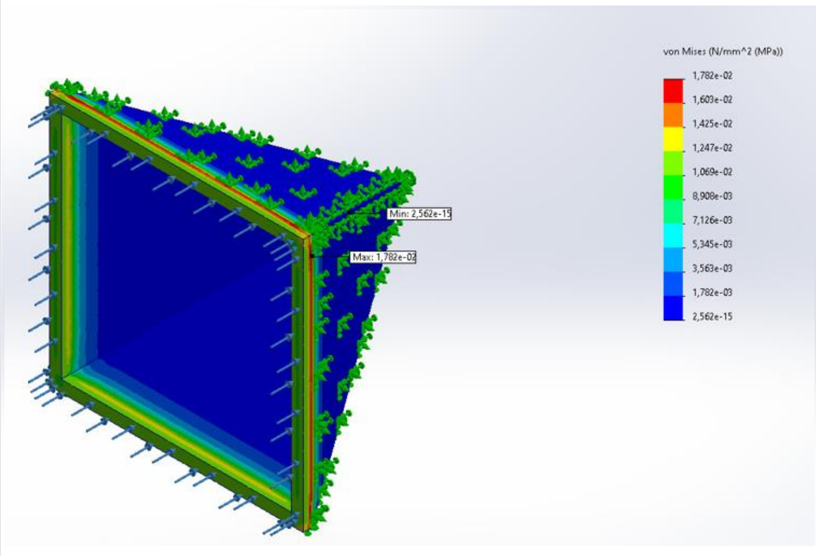
Displacement

Minimum :
$1{,}000 \times 10^{-30}$ mm

Maximum :
$8{,}802 \times 10^{-06}$ mm

Safety factor :

> 5



Axial Stress (σ)

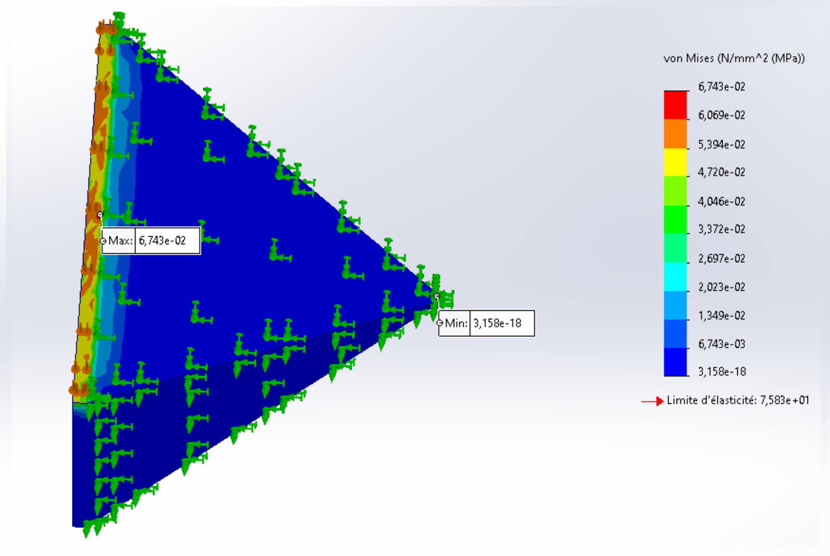
Von Mises stress

Minimum :
$2{,}562 \times 10^{-15}$ Mpa

Maximum :
$1{,}782 \times 10^{-02}$ Mpa

Yield strength :
$7{,}583 \times 10^{+01}$ Mpa

Safety factor :
> 5



Shear Stress (τ)

Von Mises stress

Minimum :
$3{,}158 \times 10^{-18}$ Mpa

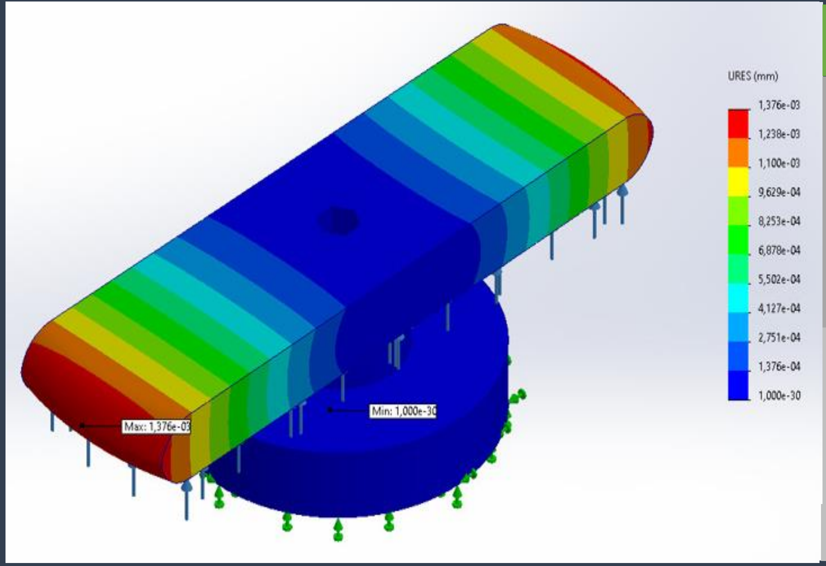
Maximum :
$6{,}743 \times 10^{-02}$ Mpa

Yield strength :
$7{,}583 \times 10^{+01}$ Mpa

Safety factor :
> 5

MECHANICAL ANALYSIS

ATTACHMENT SYSTEM



Axial Stress (σ)

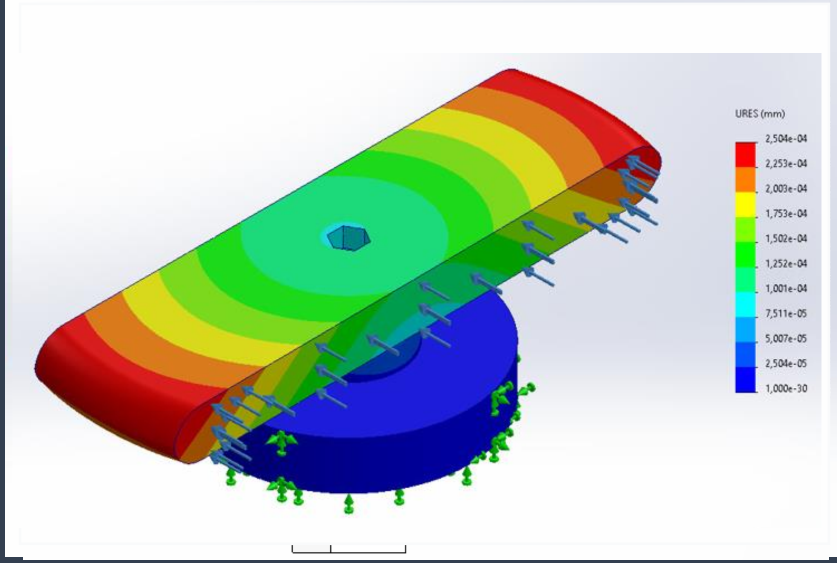
Minimum :
$1,000 \times 10^{-30}$ mm

Maximum :
$1,376 \times 10^{-03}$ mm

Safety factor :

> 5

Displacement



Shear Stress (τ)

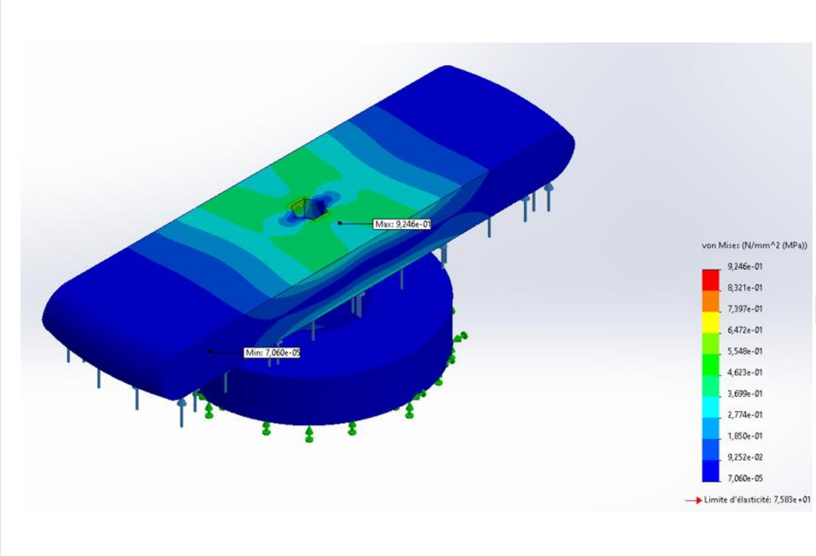
Minimum :
$1,000 \times 10^{-30}$ mm

Maximum :
$2,504 \times 10^{-04}$ mm

Safety factor :

> 5

Displacement



Axial Stress (σ)

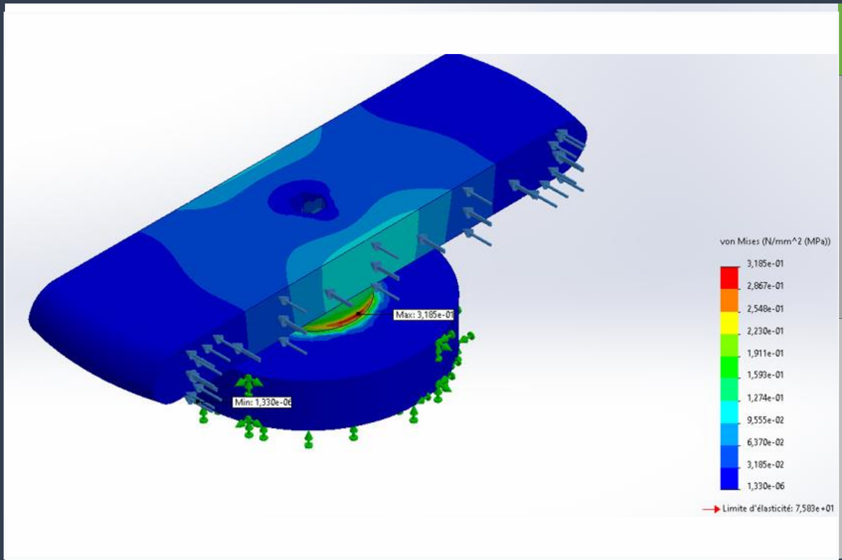
Minimum :
$7,060 \times 10^{-05}$ Mpa

Maximum :
$9,246 \times 10^{-01}$ Mpa

Yield strength :
$7,583 \times 10^{+01}$ Mpa

Safety factor :
> 5

Von Mises stress



Shear Stress (τ)

Minimum :
$1,330 \times 10^{-06}$ Mpa

Maximum :
$3,185 \times 10^{-01}$ Mpa

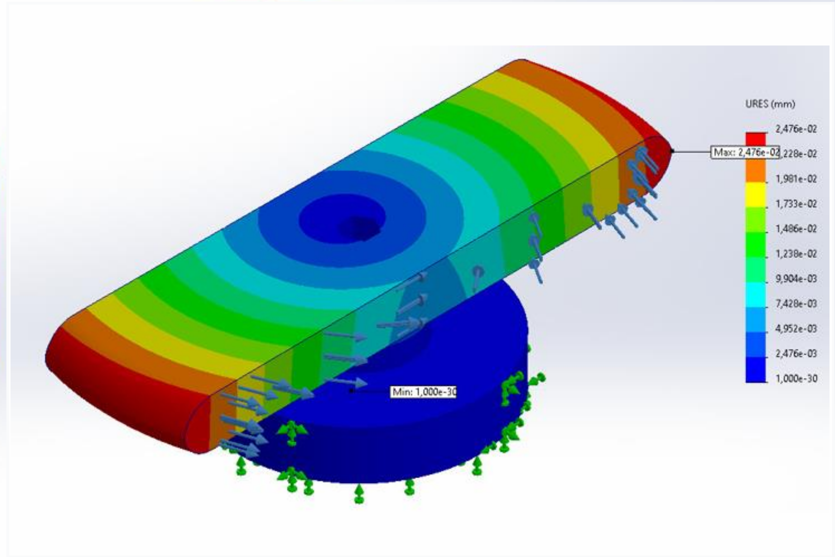
Yield strength :
$7,583 \times 10^{+01}$ Mpa

Safety factor :
> 5

Von Mises stress

MECHANICAL ANALYSIS

ATTACHMENT SYSTEM



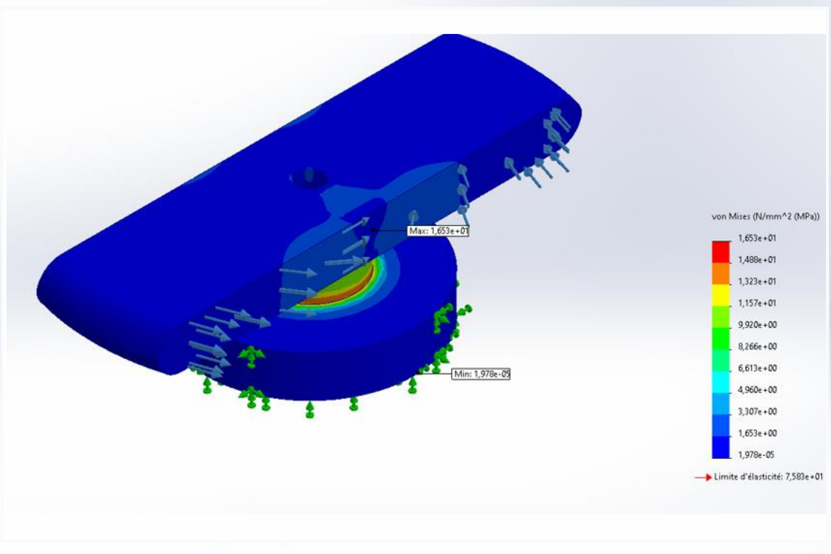
Torsional Stress (τ) — Displacement

Minimum :
$1{,}000 \times 10^{-30}$ mm

Maximum :
$2{,}476 \times 10^{-02}$ mm

Safety factor :

> 5



Torsional Stress (τ) — Von Mises stress

Minimum :
$1{,}978 \times 10^{-05}$ Mpa

Maximum :
$1{,}653 \times 10^{+01}$ Mpa

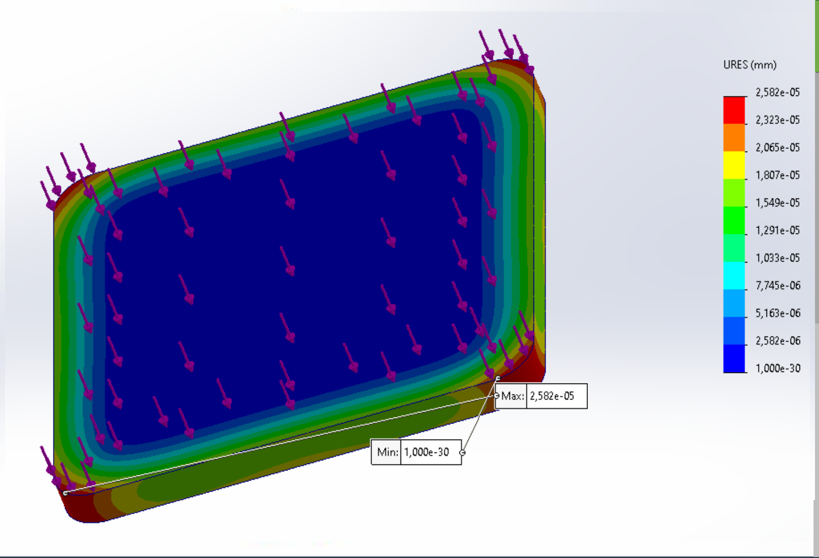
Yield strength :
$7{,}583 \times 10^{+01}$ Mpa

Safety factor :
> 5

Final product

MECHANICAL ANALYSIS

MODULE COVER



Axial Stress (σ)

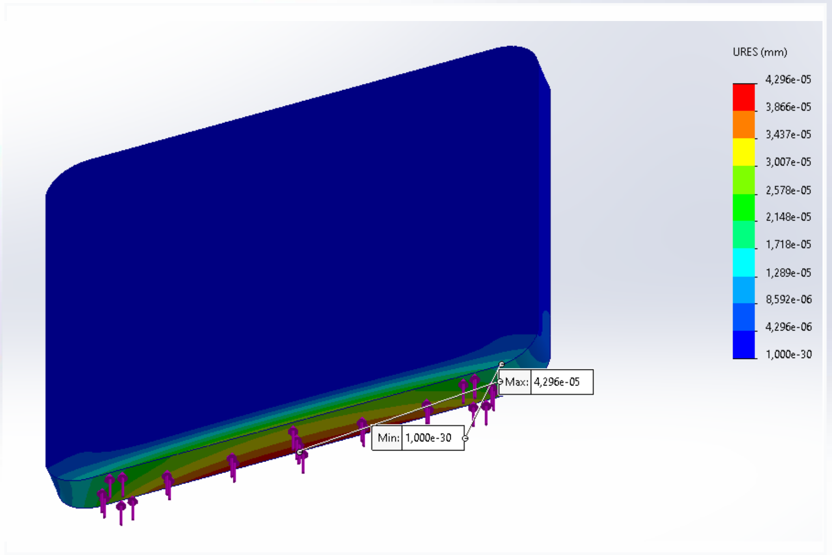
Minimum :
$1{,}000 \times 10^{-30}$ mm

Maximum :
$2{,}582 \times 10^{-05}$ mm

Safety factor :

> 5

Displacement



Shear Stress (τ)

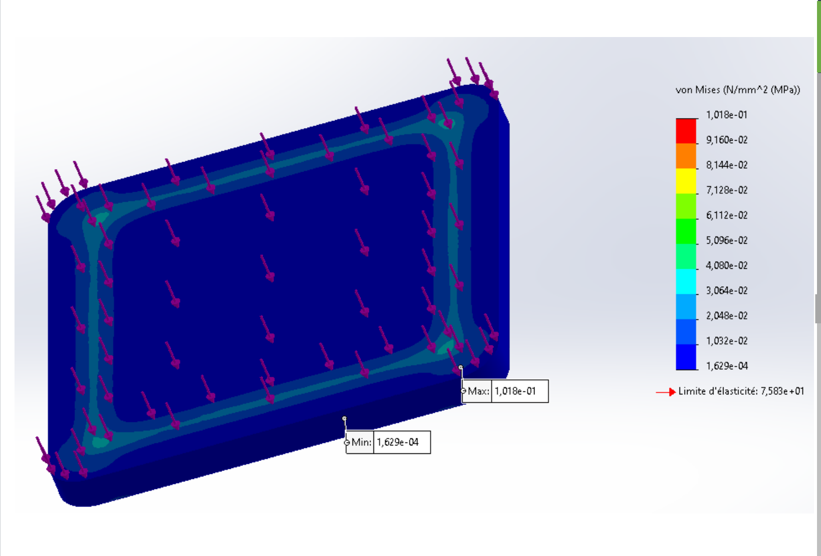
Minimum :
$1{,}000 \times 10^{-30}$ mm

Maximum :
$4{,}296 \times 10^{-05}$ mm

Safety factor :

> 5

Displacement



Axial Stress (σ)

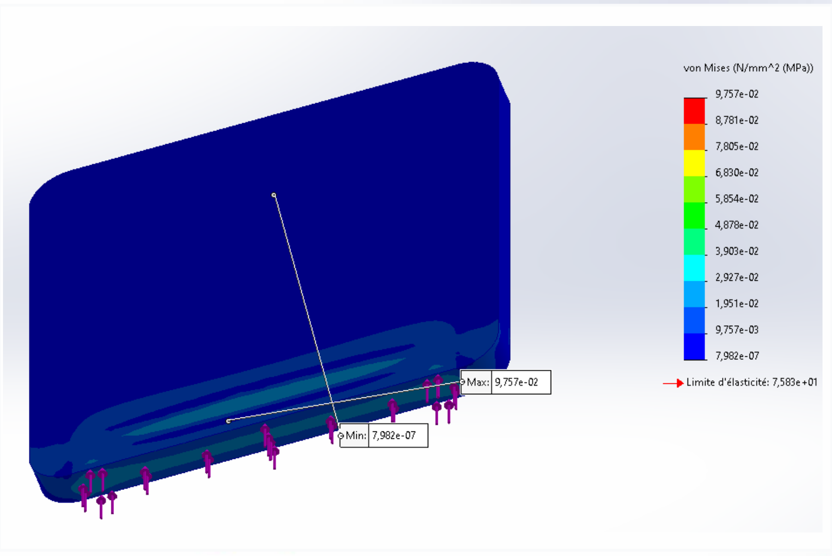
Minimum :
$1{,}629 \times 10^{-04}$ Mpa

Maximum :
$1{,}018 \times 10^{-01}$ Mpa

Yield strength :
$7{,}583 \times 10^{+01}$ Mpa

Safety factor :
> 5

Von Mises stress



Shear Stress (τ)

Minimum :
$7{,}982 \times 10^{-07}$ Mpa

Maximum :
$9{,}757 \times 10^{-02}$ Mpa

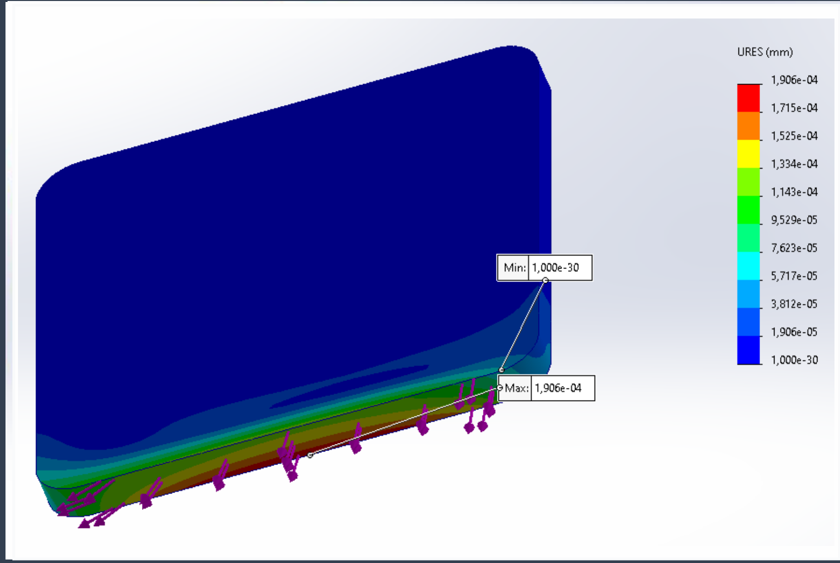
Yield strength :
$7{,}583 \times 10^{+01}$ Mpa

Safety factor :
> 5

Von Mises stress

MECHANICAL ANALYSIS

MODULE COVER



Torsional Stress (τ)

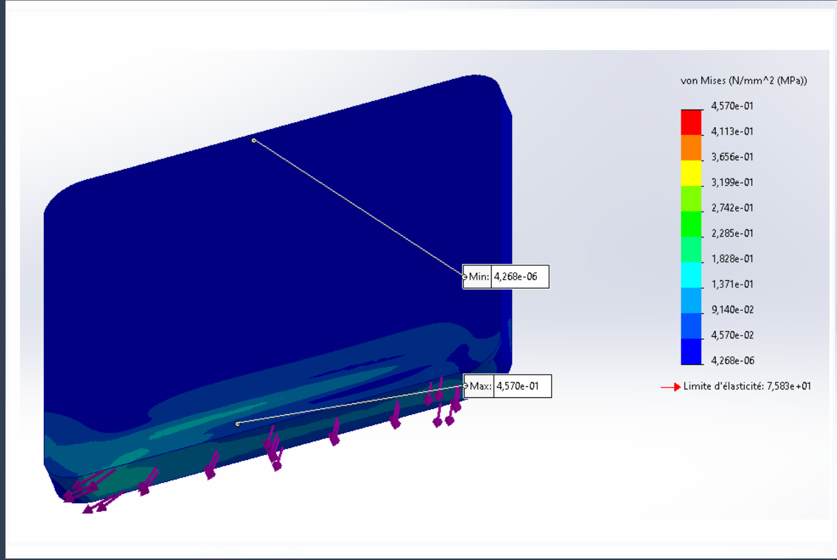
Displacement

Minimum :
$1{,}000 \times 10^{-30}$ mm

Maximum :
$1{,}906 \times 10^{-04}$ mm

Safety factor :

> 5



Torsional Stress (τ)

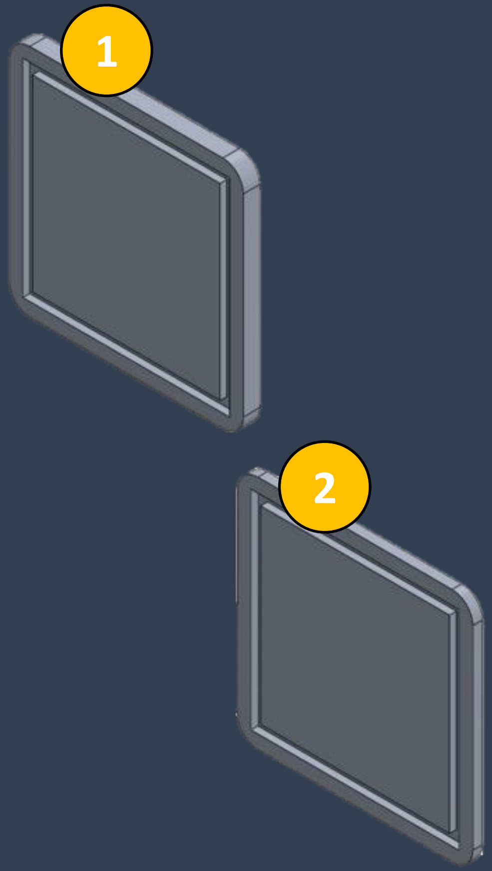
Von Mises stress

Minimum :
$4{,}268 \times 10^{-06}$ Mpa

Maximum :
$4{,}570 \times 10^{-01}$ Mpa

Yield strength :
$7{,}583 \times 10^{+01}$ Mpa

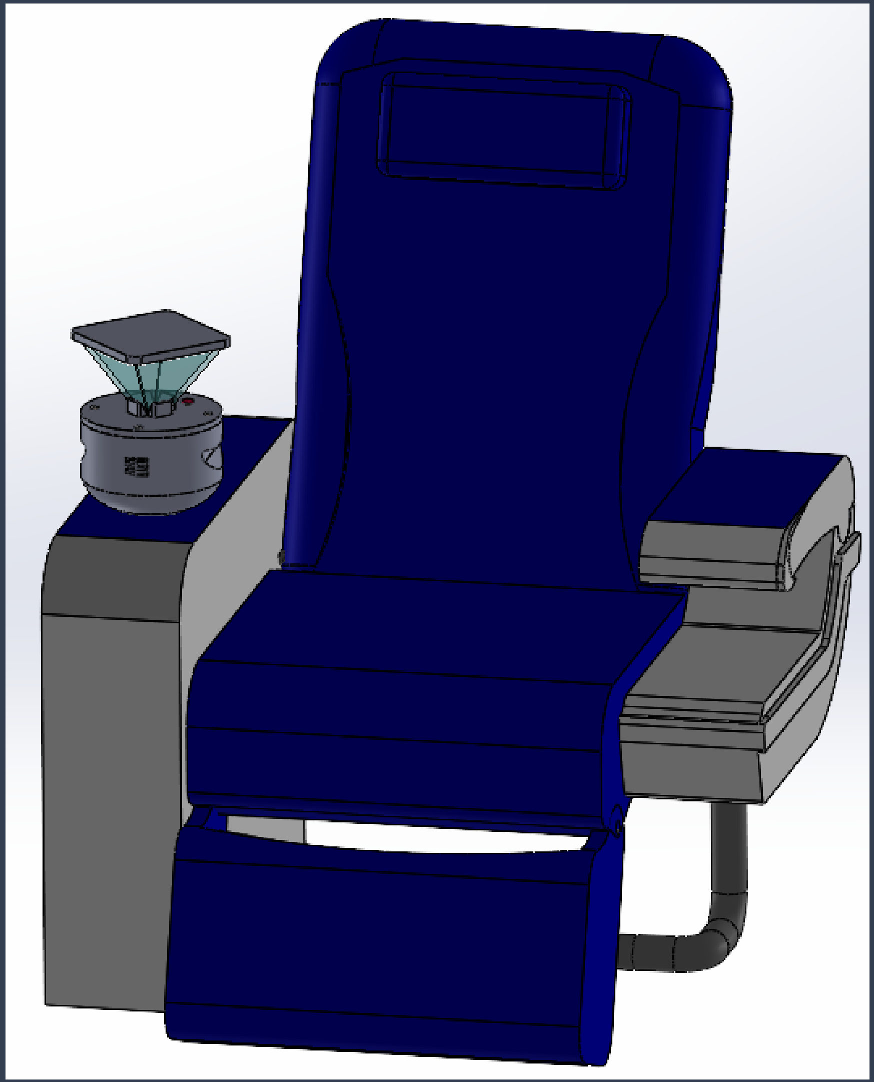
Safety factor :
> 5



Final product

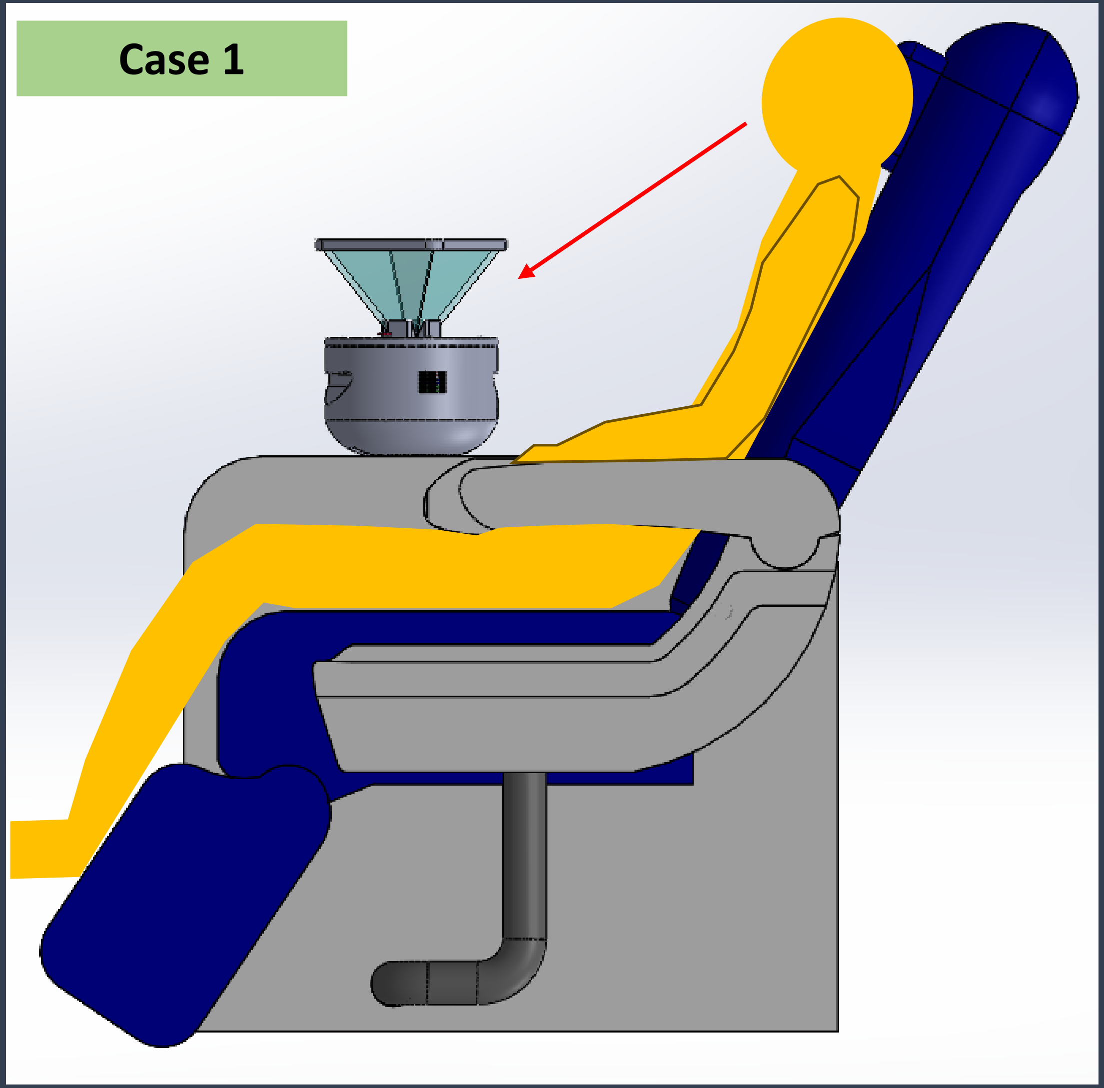
IMPLEMENTATION

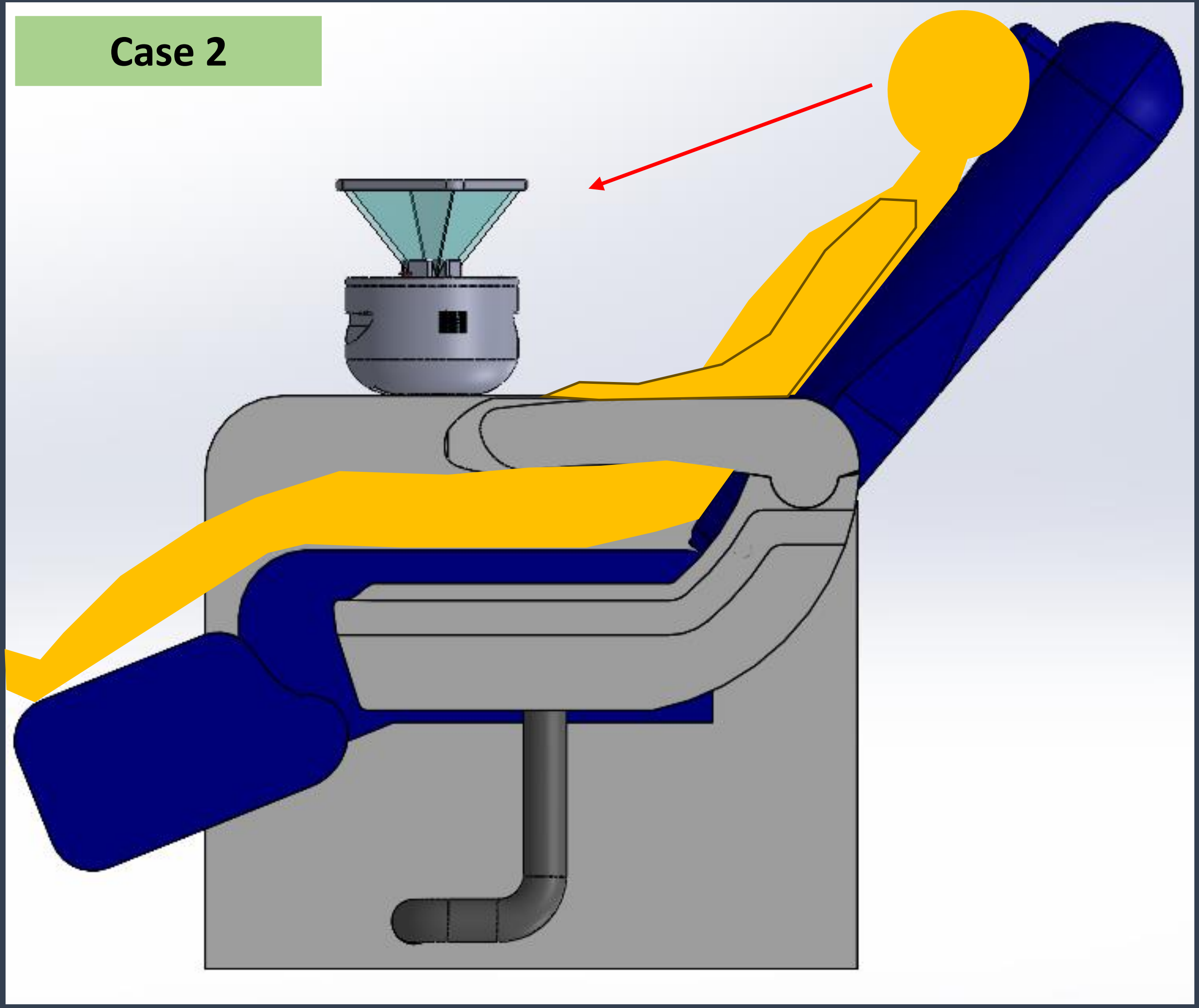
SEAT VIEW



IMPLEMENTATION

USER

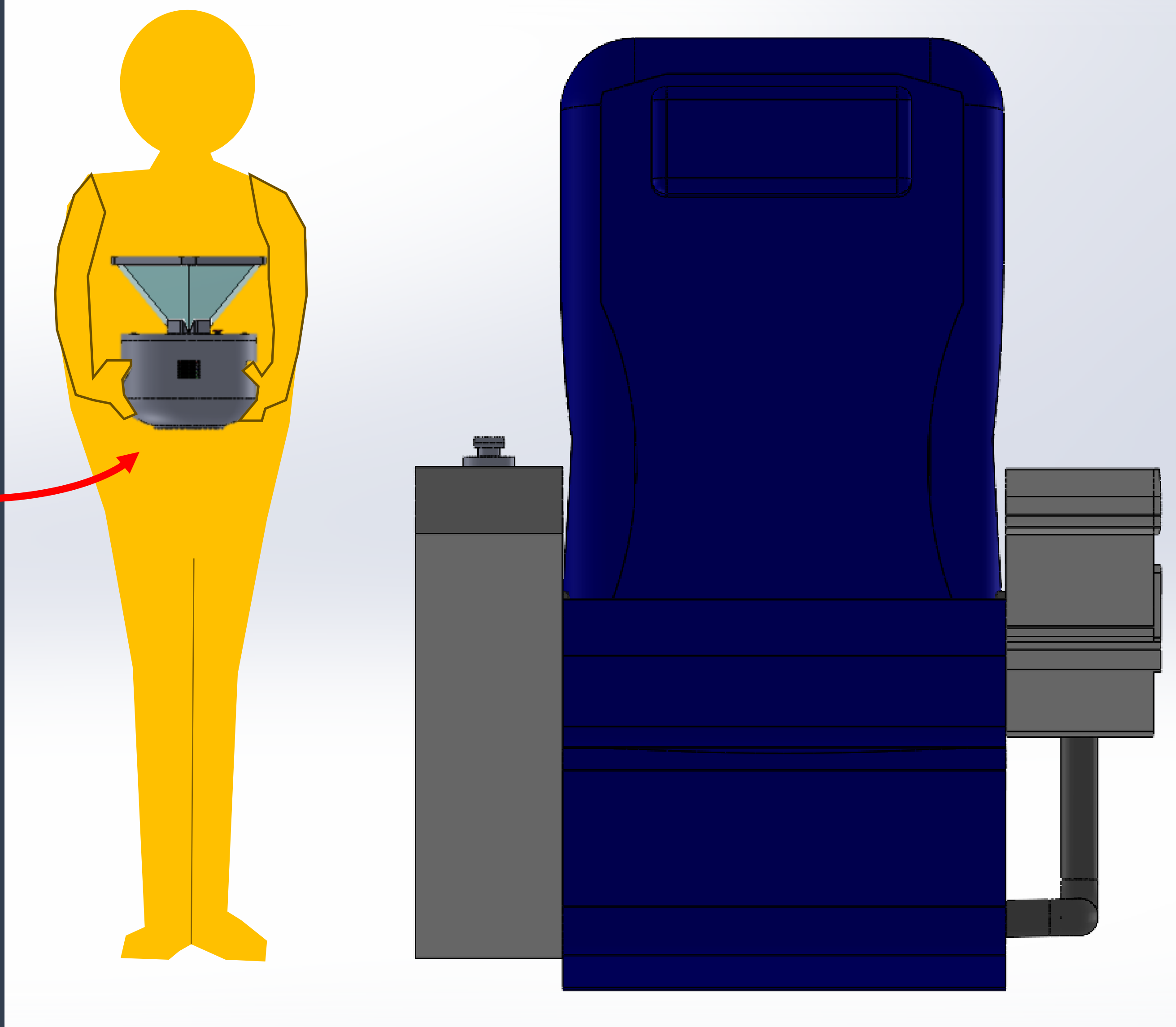




IMPLEMENTATION

PORTABLE

5,5 kg



COST ANALYSIS

ELECTRONICS

Component name	Price (€ HT)	URL
SST-20-WCS-A120-L4651	0,52	SST-20-WCS-A120-L4600 Luminus Devices | Mouser France
P-C Lens Ø 50 mm	1,16	Lentille de verre Concave convexe Double, 30mm 40mm 50mm, longueur focale 50mm 75mm 100mm 150 mm 300mm, optique pour projecteur, bricolage - AliExpress 1420
DLP471TPFQQ	214,23	DLP471TPFQQ Texas Instruments | Mouser France
P-C Lens Ø 30 mm	10,6	Jimdary Lentille Convexe en Verre Optique, lentille Convexe de diamètre K9 30mm, pour lentille loupe Bricolage lentille d'expérimentation Optique Physique : Amazon.fr: High-Tech
Circular polarizer filter	18,3	Amazon Basics - 77 mm Filtre de Protection Polarisant Circulaire pour des Couleurs Plus Profondes, Réduction des Reflets et des Éblouissements, Multi-Couches, Protège contre la Poussière : Amazon.fr: High-Tech
Beamsplitter (Polka Dot)	149	Polka Dot Beamsplitters
Fans (×2)	7,09	JZK Lot de 2 mini ventilateurs 50 x 50 x 10 mm 2 broches DC 5 V avec câbles 5010 - Petit ventilateur silencieux - 50 mm - 5 cm - 5 V - Sans balais - DC - Pour boîtier PC - Avec câble et prise : Amazon.fr: Informatique
Battery	20,99	Gecoty® Batterie 9,6V 2400mAh Ni-MH AA Rechargeable avec câble de Charge (Prise Tamiya) : Amazon.fr: High-Tech

Total price (electronic)
421,89 €

COST ANALYSIS

MECHANICAL SYSTEM

Component name	Price (€ HT)	URL
Cover	2,2	
Projection frame	19	Pet G Plaque incolore transparent 1000 x 600 x 3 mm alt-Intech® : Amazon.fr: Commerce, Industrie et Science
Enclosure lid	3,5	
Enclosure	16,07	
System attachment	1,03	
Plastic electronic component	12	

With a price of 2,6€/kg for aluminium

Total price (Module components)
53,8 €

COST ANALYSIS

TOTAL PRICE

Total price (electronics)
421,89 €

Total price (Module components)
53,8 €

Total price before charges (Entire module)
475,69 €

Total price after charges (Entire module)
2575,69 €

Planning :

	22/10/2024	05/11/2024	25/11/2024	11/12/2024	Role	TOTAL (hours)	TOTAL (salary)
Alexandre C.	3,5	7	7	3,5	Mechanical part	21	1 050,00 €
Léo G.	3,5	7	7	3,5	Electrical part	21	1 050,00 €
						42	2 100,00 €

Engineer hourly rate	50

LEAD TIME

Design time :
Between 15 and 17 hours

Production time (assumption with metal printing)
Between 20 and 25 hours

Production time (assumption with plastic printing)
Between 6 and 8 hours

In standard production → *These data will vary if the module is produced in a production line.*

CONCLUSION

An innovative solution.

Low cost.

Low weight, which can be reduced.

Easy-to-use system.

Portable but also can be fixed.

Easy and quick to produce.