Escuela de Ingeniería Industrial

TRABAJO FIN DE GRADO

Blind automation system

Cálculo de Máquinas

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1 INTRODUCTION

This project consists of the design of an automation system for blinds for domestic use.

We are looking for a system that avoids the need for a complex installation, trying to achieve a solution that allows it to be easily assembled or disassembled without changing the existing system of blinds or roller blinds, being a complementary system.

Figure 1: Complex installation

Figure 2: Complex installation

The continuous advance of technology and the increase in demand from people for home automation systems has meant that this field is in great demand. This trend has meant that these systems are continually evolving, seeking ever simpler solutions with the same features, which is why it has been decided to design a mechanism capable of raising and lowering blinds without the need to dismantle or change existing manual systems, with easy installation and connectivity that allows the automation of this process.

This system is based on the mechanism of a gearbox, where a train of gears is used to reduce the high revolutions of a motor to values in accordance with its operation.

This project will detail the objectives to be met for the design of the prototype, such as the design of the art of this type of system, the conceptual design with the different phases of the process to create this mechanism and its subsequent detailed design of the elements that compose it, as well as the calculations used for its development and the method of implementation in the home automation system.

In addition, the whole procedure will be supported by different simulations carried out with the software, different solutions will be evaluated and documented with drawings. A summary of the performance of the final system and suggestions for its use will be provided. Finally, a market launch will be carried out with a competent budget compared to the existing system, and conclusions and future lines of action for this project will be detailed.

2 REQUERIMENTS AND OBJECTIVES

2.1 Requeriments

The design of this system seeks to meet the most important needs demanded by the potential user.

The requirements to be met are:

- Creation of a mechanism as compact as possible.
- Design compatible with different roller shutter/blind mechanisms.
- Simple installation and assembly.
- Simple disassembly for possible component replacement.
- Design of an economical system, with a correct functionality-price ratio.
- Design adaptable to different types of power supply.
- Easy automation and control.

Figure 3: Automation of the mechanism

2.2 Objectives

The general objective of this project is the design and study of an automation system for blinds/shutters, based on the mechanism of a gearbox, which is economical, efficient and easy to install.

It is focused on domestic use, however, its use can go beyond this, being used in offices and industries, which have a system of blinds or shutters similar to those used in the home, allowing the domotisation of several mechanisms at the same time.

In addition, an installation is sought that avoids the need for wall perforation, changes to existing elements, the use of drills, anchors or screws, etc. Its installation will be complementary and is based on the placement of the strap or tape of the blind on the element, leaving it hanging in the air or glued to the wall by means of adhesive.

The specific objectives to be met in this project are:

- Study and analysis of the reduction system belonging to the mechanism.

- Development of the system and complements to adapt to different mechanisms.
- Proposal of a final design that meets the requirements demanded.
- Modelling of the system in SolidWorks.
- Analysis through simulations in SolidWorks and KISSsoft.
- Dimensioning and justification of the components
- Preparation of drawings in SolidWorks and AutoCad.
- Preparation of a competent quotation.
- Adaptation of the system for 3D printing and use of Ultimake Cura 3D software.
- Testing and implementation in real domestic use.

Figure 4: Real use of the system

3 SUPPORTING CALCULATIONS

3.1 Main calculations

In order to be able to design the gear train, some calculations are carried out beforehand to obtain the characteristic parameters that define it and to achieve the required speed reduction.

At the input, the rotation speed provided by the motor is 5100 rpm, however, this speed is too high to carry out the movement of the blinds, so a gear train is designed to reduce the output speed to 40 rpm. Therefore, some of the parameters used to obtain this gear train with a transmission ratio are defined below $\frac{2}{255}$.

- **Module (m):** This is the ratio between the primitive diameter and the number of teeth, a value of 0.8 being set on the basis of the power to be transmitted and the transmission ratio.

- **Primitive diameter ($\boldsymbol{D_p}$):** This is the diameter along which the teeth mesh, being the fundamental value of the gearing and the starting point for its calculation.

$$D_p = m * z$$

- **Outer diameter ($\boldsymbol{D_e}$):** It is the diameter corresponding to the outer circumference.

$$D_e = m * (z + 2)$$

- **Inner diameter ($\boldsymbol{D_i}$):** It is the diameter corresponding to the inner circumference.

$$D_i = m * (z - 2{,}5)$$

- **Transmission ratio (i):** The ratio between the rotational speeds of two connected gears, where one of them exerts force on the other.

$$i = \frac{n_{1\,(input)}}{n_{2\,(output)}}$$

- **Distance between centres ($\boldsymbol{D_c}$):** It is the distance between the axles of the wheel and the pinion, where D_p corresponds to the gearbox pitch diameter and d_p to the pinion pitch diameter.

$$D_c = \frac{(D_p + d_p)}{2}$$

The results obtained after the calculation process are tabulated below:

Table 1: Summary of calculations

Gear	Z	n	D_e	D_p	D_i	i	D_c	Shaft
1	12	5100,00	11,20	9,60	7,60	-	0,00	Engine
2	72	850,00	59,20	57,60	55,60	0,17	34,00	1,00
3	16	850,00	14,40	12,80	10,80	1,00	0,00	1,00
4	68	200,00	56,00	54,40	52,40	0,24	34,00	2,00
5	24	200,00	20,80	19,20	17,20	1,00	0,00	2,00
6	60	80,00	49,60	48,00	46,00	0,40	34,00	3,00
7	28	80,00	24,00	22,40	20,40	1,00	0,00	3,00
8	56	40,00	46,40	44,80	42,80	0,50	34,00	4,00

It should be noted that for the design of the pinion (gear 1) and gear 2, those provided in the SolidWorks library, DIN standard, have been selected, being bevel gears with straight teeth. For their definition, the following properties are provided:

Table 2: Definition of properties

Properties	Gear 1 (pinion)	Gear 2
Module	0,8	0,8
No. of teeth	12	72
Nº of teeth of the pinion	72	12
Pressure angles	20	20
Face width	5	5
Cube diameter	8	10
Mounting distance	2,8	7,4

3.2 Tooth dimensioning

For the dimensioning of the tooth, different calculations and terms are made, some of them being the following:

- **Circular pitch (p):** Also called circular or circumferential pitch, it is the distance measured on the primitive circumference between homologous points of two consecutive teeth.

$$p = m * \pi$$

- **Adendum or head height (h_a):** It is the measurement from the primitive circumference to the outer circumference or crest of the tooth, corresponding to the modulus.

$$a = m$$

- **Dedendum or foot height (h_f):** It is the measurement from the inner circumference to the prime circumference.

$$d = 1{,}25 * m$$

- **Whole depth (h):** It is equal to the sum of the head and foot heights, being for a standard reference profile the following.

$$h = 2{,}25 * m$$

- **Top clearance (c):** The space between the head of a tooth and the bottom of the interdental space of the wheel with which it engages.

$$c = 0{,}25 * m$$

- **Working or active height ($\boldsymbol{h_w}$):** It is the difference between the total height of the tooth and the clearance.

$$h_w = h - c$$

- **Tooth thickness (s):** It is the thickness of the tooth, measured on the primitive circumference.
  The value used will be s=0.458, provided by SolidWorks, according to the DIN standard.

- **Tooth gap (v):** It is the distance between two consecutive teeth, measured on the primitive circumference.
  The value used will be v=0.542, provided by SolidWorks, according to the DIN standard.

- **Pressure angle (α):** The angle at which the driving force between two gears is at its maximum.

$$\alpha = 20^{\circ}$$

The results of the calculation are shown below:

Table 3: Summary of tooth dimensioning

TOOTH DIMENSIONING	
Circular pitch	2,513
Adendum	0,800
Dedendum	1,000
Whole depth	1,800
Top clearance	0,200
Working or active height	1,600
Thickness	0,458
Gap	0,542
Pressure angle	20,000

As a summary of the dimensions of these teeth, they can be seen graphically in the following picture:

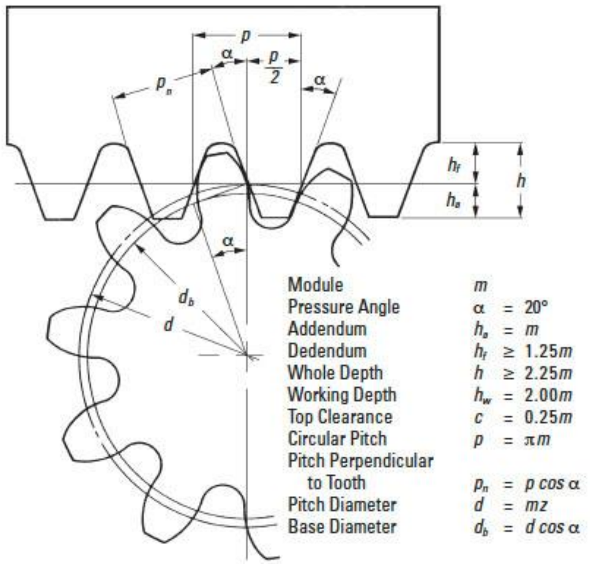


Figure 5: Tooth profile

4 DESIGN

4.1 Materials used

As for the material used in this design, steel is used for the machining of gears and shafts, while the box, supports and the pulley responsible for the movement of the blinds will be made of PLA.

Figure 6: Steel gears

PLA is a thermoplastic that is used in 3D printers, which is why it is used, as the box, supports and pulley will be printed using this process.

Additionally, in order to obtain the design for home use, it was decided to 3D print it with all the components in PLA. This model will not be exactly the same design, but an approximate element, as the calculation of plastic gears is governed by other standards, such as VDI 2376.

Figure 7: Plastic gears

4.2 General design

This is followed by a schematic of the design procedure, which will be explained in more detail in the next section.

Initially, the design of the shafts and gears is carried out, based on the calculations made, in order to assemble the gear train. This is connected to the motor shaft from a pair of curved gears, resulting in the assembly of the aforementioned as shown in the following image.

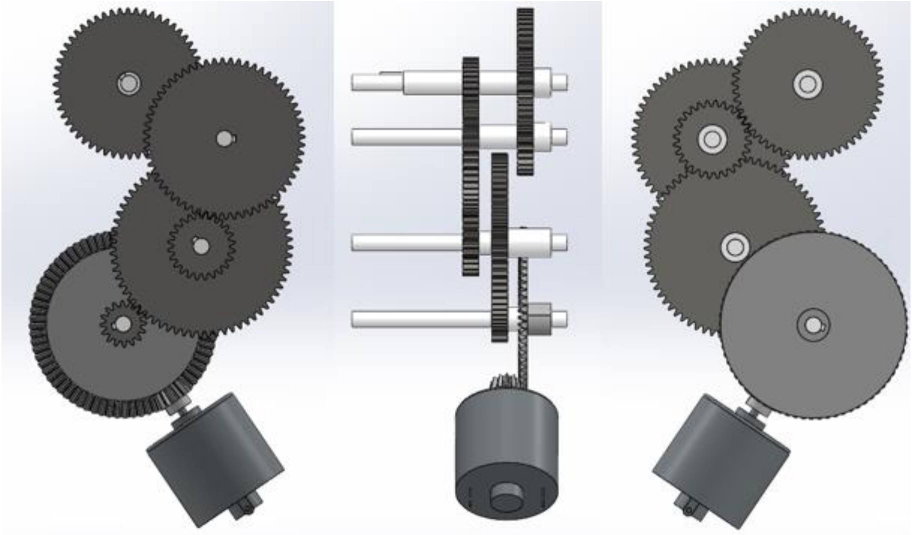


Figure 8: Gear train

Once the gear train is assembled, the design of the part that will transmit the movement to the blinds (yellow), the communications module (white) and the power transformer (grey) is carried out.

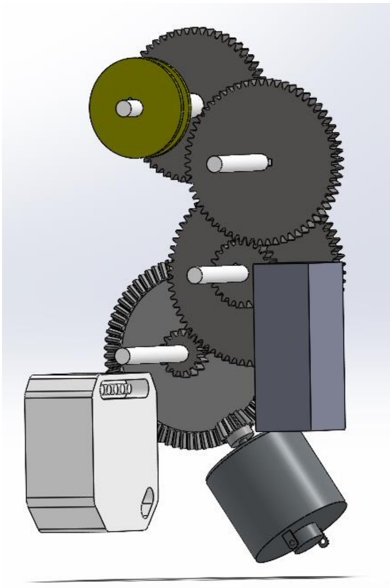


Figure 9: Gear train with components

The mechanism box is then designed, with its corresponding supports for each piece, as well as the opening through which the blind belt will run.

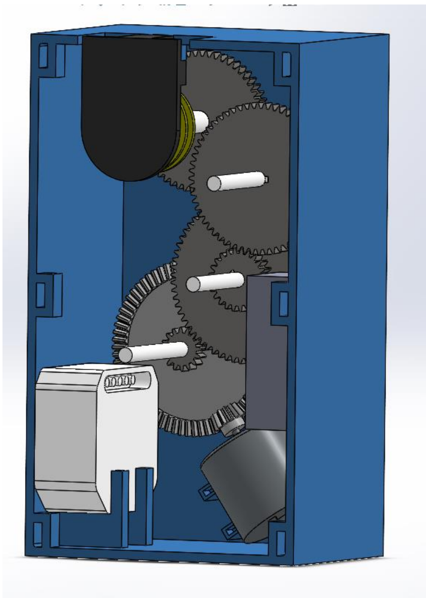


Figure 10: Box assembly

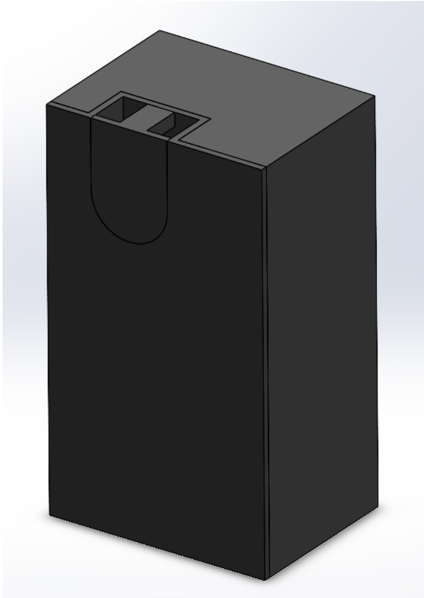


Figure 11: Box

4.3 Explanation of the design in SolidWorks

4.3.1 Gears box

As this design will be made using a 3D printer, all the fastenings of the external components and axles are designed, so that everything fits perfectly and has a simple and precise assembly.

The first thing to be done is the support for the motor, as the first gear of the train is positioned on it and the rest are placed from there, so that the size of the box is as small as possible. To fix it, two main supports are made with a semicircle with a diameter equal to that of the motor, and two lateral supports to finish fixing the possible displacement of the motor and to ensure that it is well fixed.

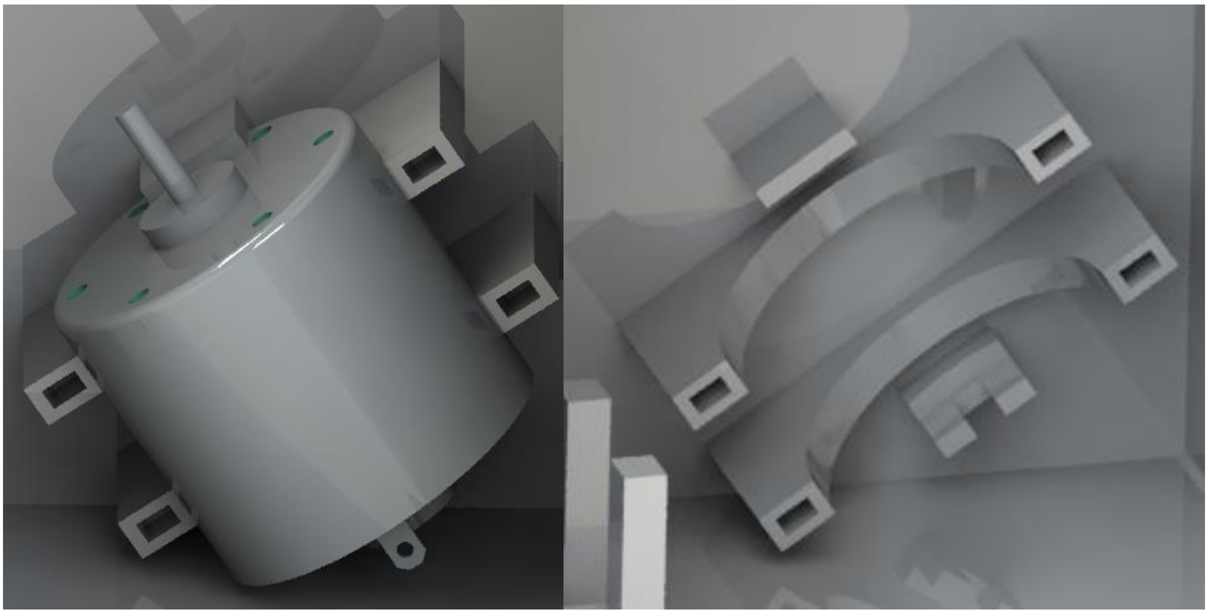


Figure 12: engine mount detail

As can be seen, the main brackets have square grooves, designed to fit the cover perfectly into the grooves to prevent the cover from slipping or sliding as the engine rotates.

It should be noted that a cut is made in the rear side support to fit the rear pin and thus avoid possible rotation of the motor.

Once the motor has been fixed, the position pattern of the axles is made, looking for the most optimal placement to occupy the minimum space and taking into account that the rest of the components must be placed. To fix them, four supports are extruded in the form of circular crowns with an inner radius of 5mm and an outer radius of 10mm, protruding by 5mm.

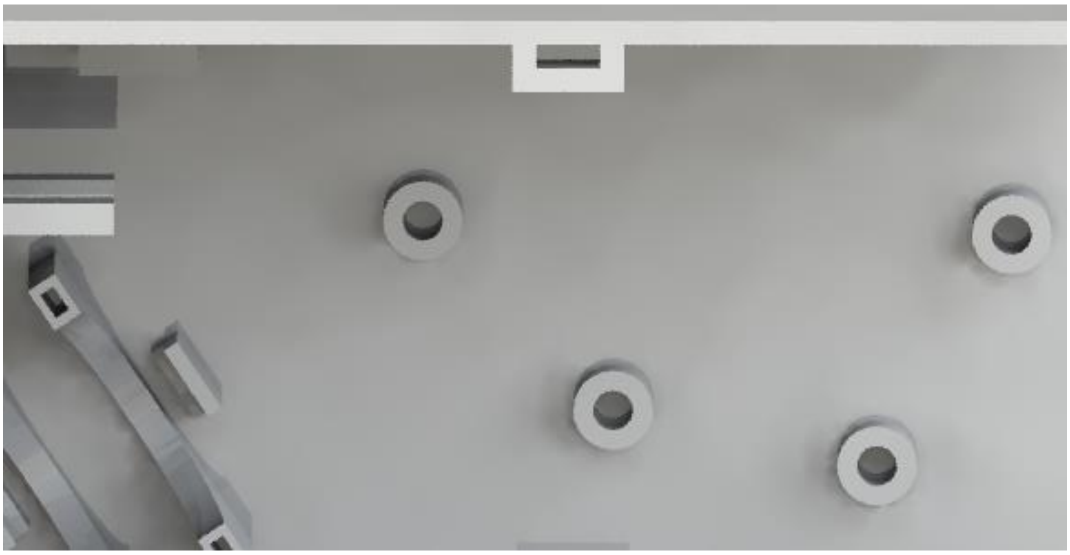


Figure 13: shaft fasteners detail

Once the gears are in place, the rest of the components are placed, namely the transformer and the Bluetooth switch. For the former, no support is needed, as it will be fixed with double-sided tape to the wall of the box, while for the switch a support is made consisting of 3 supports, two lower ones that place it and limit the movement in 2 axes, and the third one being located in such a way that it limits the movement in the remaining axis by fixing it against the cover.

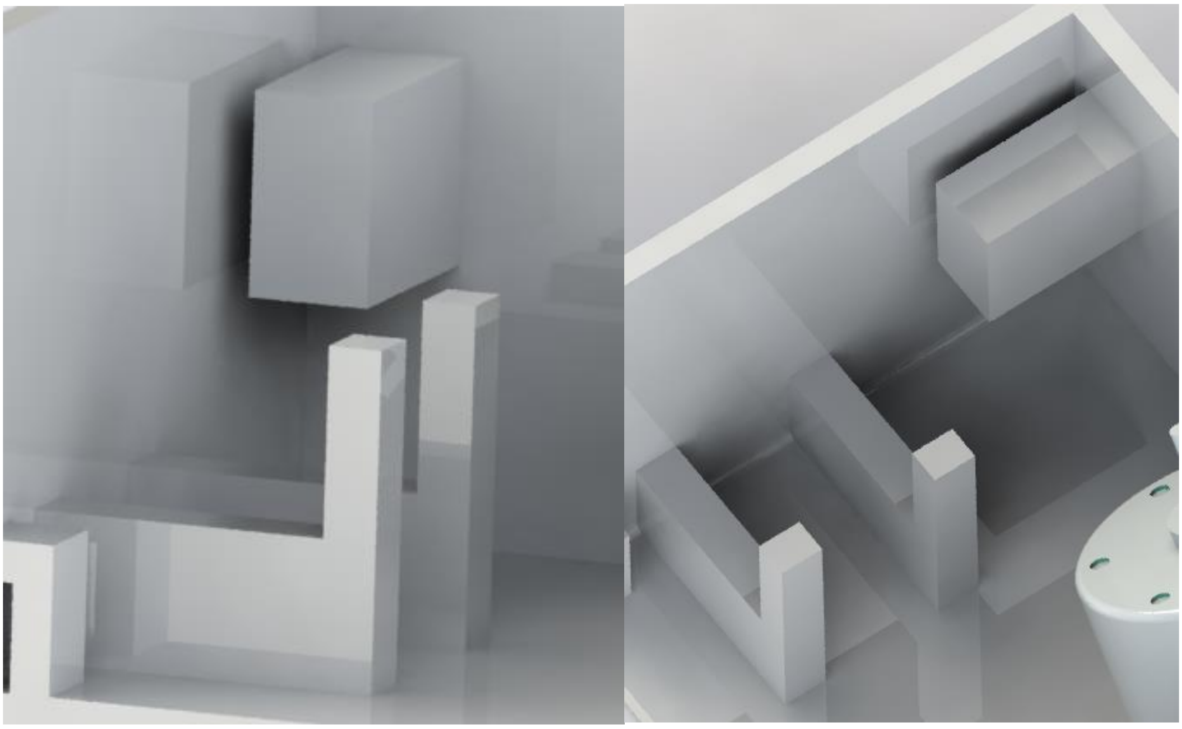


Figure 14: switch attachment detail

For this design, a press-fit system was devised, thus avoiding the use of screws to close the system. In the box you can see the "female" hooks and in the cover the "male" ones will be placed, closing this way the main system perfectly. A 6mm diameter hole is also left for the power cable to pass through.

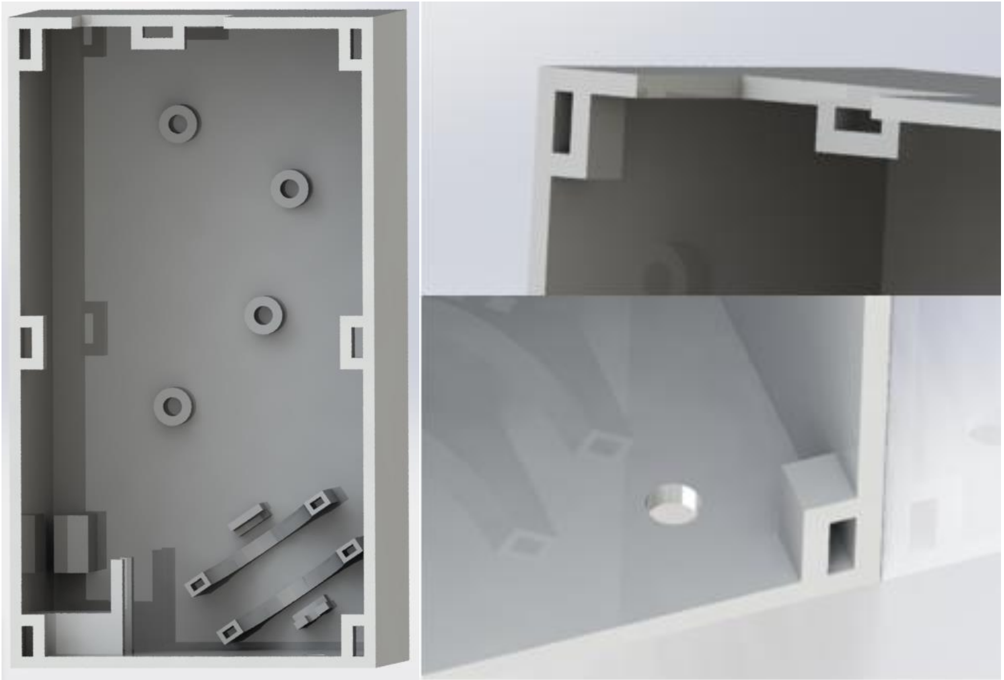


Figure 15: detail of press fittings and cable hole

4.3.2 Cover of the box

This element is designed in a symmetrical way to the box, so that all the holes and supports coincide. This is why we find the axle supports in reverse, as well as the motor support, with the necessary material extrusions to fit into the grooves of the housing.

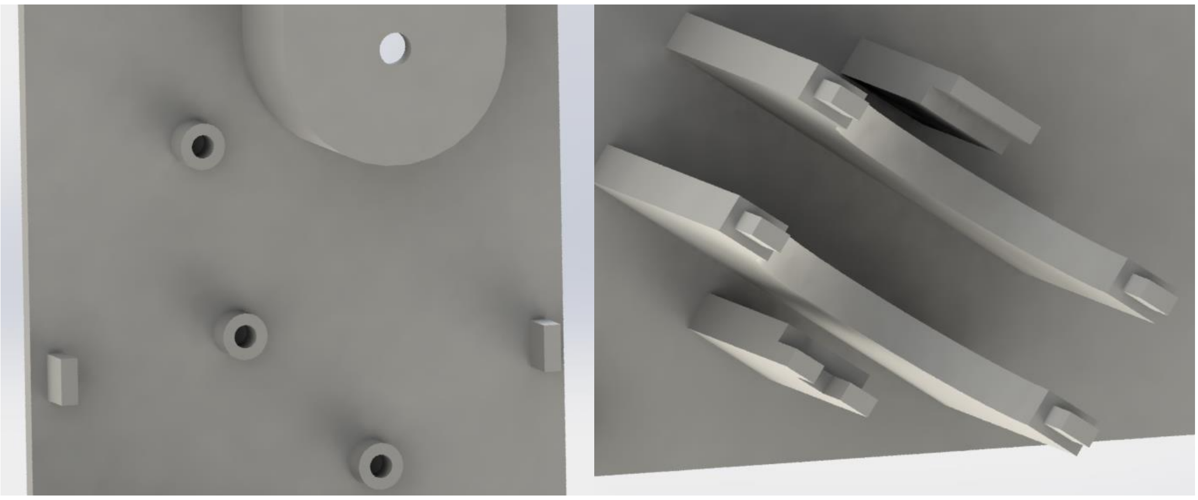


Figure 16: detail of engine mount and shaft fasteners

This is where the "male" hooks are located and is designed to hide the entire internal system, leaving only the "curtain pulley" exposed, which is the element that will be extracted to retract or extend the curtain.

4.3.3 Curtain pulley

This piece is the most important of the whole design, as it is responsible for transmitting the twist to the curtain cord and thus being able to extend or retract the curtain. It has a simple design with a groove on the inside diameter, which has semicircular cuts where the balls of the curtain cord fit into.

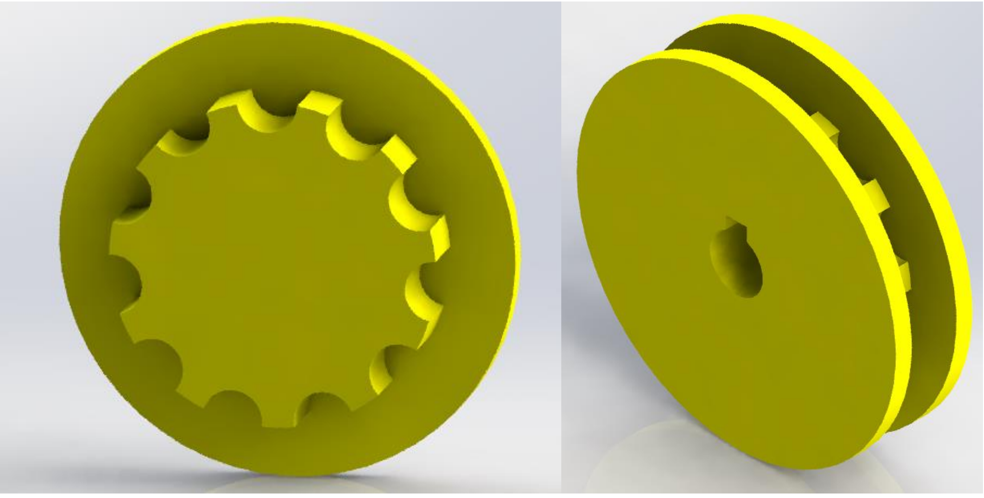


Figure 17: Curtain pulley

4.3.4 Cover of the pulley

This part is designed to allow access to the pulley without the need to disassemble the complete system.

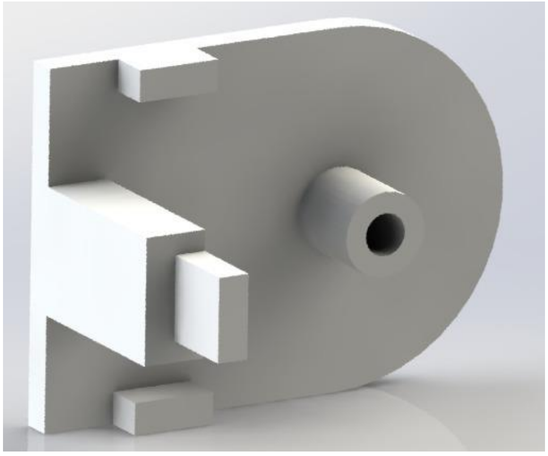


Figure 18: Cover of the pulley

5 SIMULATIONS IN SOLIDWORKS

In order to analyze the approximate behavior of the system before stresses, it was decided to perform some static simulation.

For this purpose, it was decided to use SolidWorks and not KISSsoft, since the behavior studies with plastic materials would be errors and the results would be approximate and unreliable.

For this, in the absence of the material to be used in 3D printing, which is PLA, a study is made of which material included in SolidWorks is the closest to it, resulting in PET, with the following properties:

Table 4: Properties of PET (SolidWorks)

Propiedad	Valor	Unidades
Módulo elástico	2960	N/mm^2
Coeficiente de Poisson	0.37	N/D
Módulo cortante		N/mm^2
Densidad de masa	1420	kg/m^3
Límite de tracción	57.3	N/mm^2
Límite de compresión	92.9	N/mm^2
Límite elástico		N/mm^2
Coeficiente de expansión térmica		/K
Conductividad térmica	0.261	W/(m·K)
Calor específico	1140	J/(kg·K)
Cociente de amortiguamiento del material		N/D

In its simulation, the system's own weight is used, taking into account the amount of material used and the weight of the components, being approximately 700 g of the total system, i.e. 7 N.

For the fixations, the movement is limited at the rear of the box and a parting line is created at the bottom of the shaft, where the pulley that will carry out the curtain movement is located.

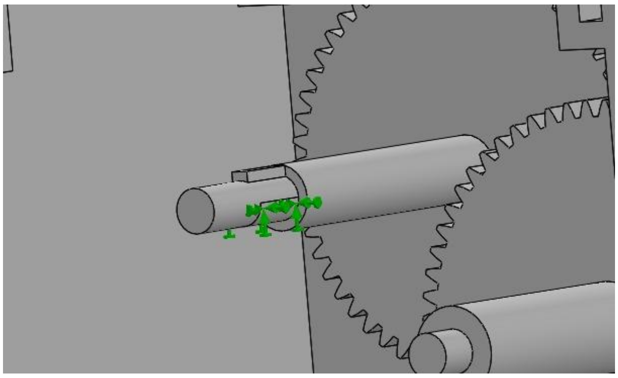


Figure 5: Localization of the partition

In the SolidWorks simulation, unrealistic stress peaks are obtained, so it was decided to use ISO surfaces to verify more realistically the location and quantification of the stress, the result is as follows:

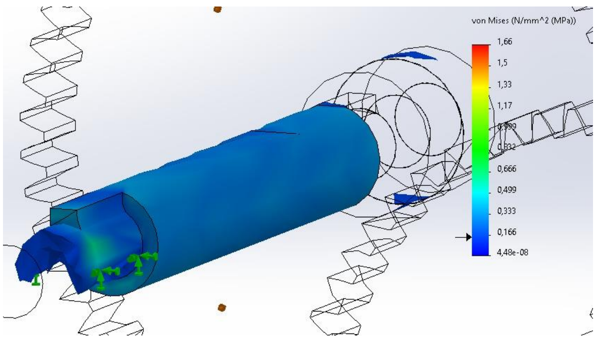


Figure 20: ISO surfaces

As can be seen, the shaft would perfectly support this weight, the forces being located at the location of the pulley. However, it is suggested to fix the mechanism to the wall by means of adhesive tape or support, or to a fixed element, thus increasing the useful life of the system, reducing the stresses in that area.

Additionally, a combined displacement simulation is carried out to observe the displacements produced once the mechanism is in place. It can be observed that the blue zone, where less displacement is produced, is where the shaft and pulley zone is fixed, which would be anchored to the curtain belt, and the lower red zone, where a displacement of approximately 0.25 mm would be produced, being a correct value for a plastic material.

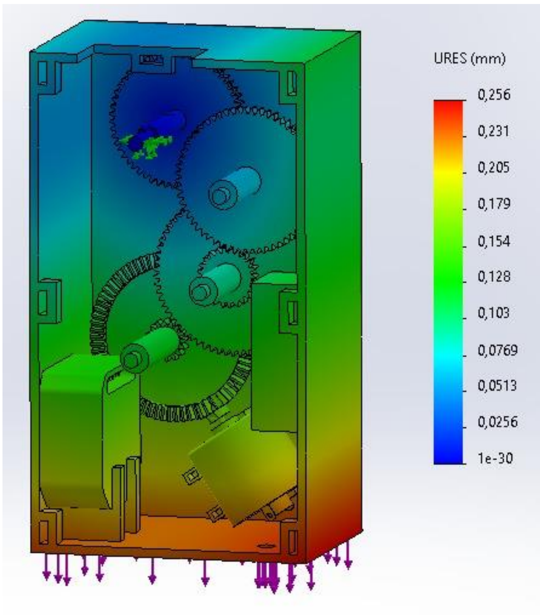


Figure 21: Combined displacement

6 DETAIL DESIGN

This section will detail those elements outside the design used in the mechanism, being commercial models and offering the link to their purchase in the budget section.

It should be noted that the elements used are adapted to the space required, seeking to find the same features in a more optimal size, designing a box that protects the complete mechanism, of not too large dimensions.

6.1 Engine

A direct current motor, model GR-18260-CVC, from the company Transmotec, will be used, with the following characteristics:

Table 5: Engine specifications

Power	3,1 W
Voltage	12 VDC
Nominal current	0,5 A
Nominal speed	5100 rpm
Nominal torque	5,9 Nm

The model used is the one described in the image, the dimensions of which are shown in the respective plan attached to this project.

Figure 22: GR-18269-CVC engine

6.2 Power cable

The power supply to the motor is provided by connecting a common power socket or base to the power transformer. For this purpose, an alternating current power cable of variable length is used, depending on the distance from the socket, and it also contains a switch in the event of not wishing to supply power to the device.

Figure 23: Power cable

6.3 Power transformer

The power supply from the socket is alternating current, while the power supply required by the motor used is direct current, so a transformer will be used to make the change from alternating to direct current.

For this purpose, the model described in the image will be used, where the power supply required by the motor is through a current of 0.5 A and 3.1 W, so the one chosen is perfectly valid.

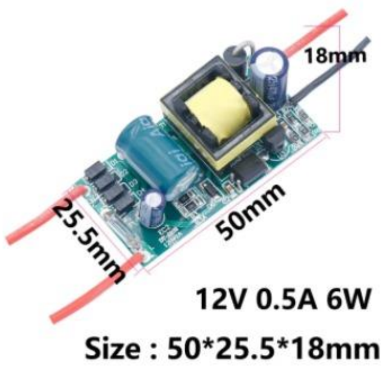


Figure 24: Power transformer

6.4 Communication module

To automate the mechanism, a WIFI communication module will be used, allowing total control of the movement of the blinds, raising or lowering them, stopping them in the desired position.

This device allows remote control by means of a remote control or by means of a mobile phone application linked to the communication module system.

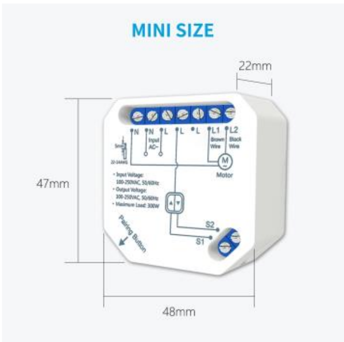


Figure 25: Communication module

7 BUDGET

7.1 Designed system

An economic estimate is made of the cost of making this mechanism, where it is repeated that this is an estimate, as the value of the machining of the gears and shafts will be approximations to commercial gears.

Initially, the price of the components printed with PLA is defined, which vary according to the price per kg of PLA. The price of the employee personally is estimated to be 20 € /kg.

The printing of the box with the supports is estimated to cost 190 g, a value extracted from the 3D printer software. Knowing this, the cost of this box is estimated to be €3.8.

As mentioned above, the price of the steel shafts and gears will be an approximation, as the price of the machining and the steel used is unknown. For this, an average will be made, from the smallest at €4 to the largest used in the gear train at €10. Having 8 gears, at an average of 7 €, makes a total of 56 €.

The shafts, however, with 7 mm, having 4 shafts, at a price of 2,94 €, will make a total of 11,76 €.

Table 6: Budget of designed system

Component	Price	Link
Engine	12,70 €	https://n9.cl/euk40
Power cable	2,65 €	https://n9.cl/jo6i0
Power transformer	1,70 €	https://n9.cl/9dcfu
Communication module	17,06 €	https://n9.cl/7f099
Supports + Box	3,8€	https://n9.cl/6ndov
Gears	56 €	https://n9.cl/o4ghj
Shafts	11,76 €	https://n9.cl/6yzzv
TOTAL	**106 €**	

7.2 Prefabricated system

The complete system would cost 106 €, which is a high price, knowing that a commercial device of similar characteristics has a price of around 70-80 €, which leads to look for an alternative.

An alternative would be the purchase of a prefabricated system such as the following:

Figure 26: Prefabricated gear train

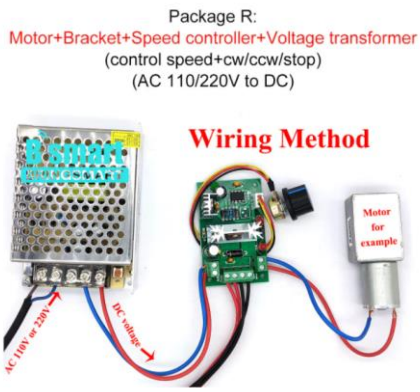


Figure 27: Package R

The system to be chosen will be the package R, with a voltage of 12 V and an output speed of 40 rpm. This system consists of the motor, bracket, gear train and transformer, with a total price of 32,09 €. This leads to a considerable cost reduction, being half of the total cost of the package.

Table 7: Budget of prefabricated system

Component	Price	Link
Package R	32,09 €	https://n9.cl/vfgpi
Power cable	2,65 €	https://n9.cl/tkf89
Communication module	17,06 €	https://n9.cl/7f099
Supports + Box	3,8€	https://n9.cl/6ndov
TOTAL	**55,6€**	

7.3 3D printing of the design

Although the design and the calculations made have been taken into account for a steel design, it was decided to 3D print the complete system in PLA, aware that it would not be the same, as it has different standards (VDI 2376, for example), but it is an approximation to check its operation.

In order to determine the cost, it is necessary to know the amount of PLA used in the printing of the box, supports, gears and shafts, which is about 400 g. Taking this into account, the personal cost would be:

Table 8: Budget of 3D printing

Component	Price	Link
Engine	12,70 €	https://n9.cl/euk40
Power cable	2,65 €	https://n9.cl/tkf89
Power transformer	1,70 €	https://n9.cl/9dcfu
Communication module	17,06 €	https://n9.cl/7f099
3D Printing	8 €	https://n9.cl/6ndov
TOTAL	**42,11 €**	

8 CONCLUSSIONS

Technology is becoming more and more part of our daily lives, where in recent years it has become fashionable to automate manual systems in the home, known as domotisation. These mechanical systems have had to adapt to this process, where we have seen the opportunity in this project to make something of this theme.

From the elaboration of some homemade concept, to later, after calculations, design and printing of a more optimal automated mechanical system.

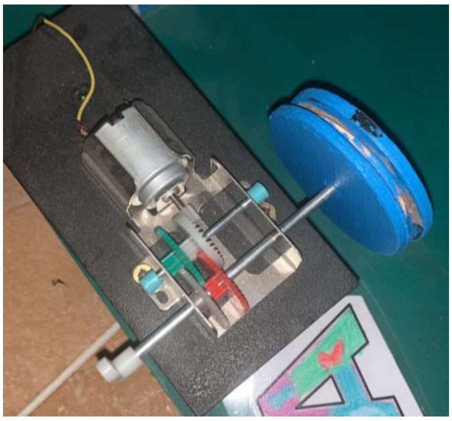


Figure 28: Home-made concept design

Now, once the project has been completed, conclusions are reached where, based on the economic evaluation, the economic value of the electronic and mechanical systems is reflected, as well as the importance of the materials used and the purpose for which the system is to be used.

In addition, from the realisation of this project, it has been possible to learn:

- Calculation of gear trains.
- Gear dimensioning.
- In-depth study of Solidworks design.
- Preparation of drawings on shafts and gears in AutoCad.
- Information about mechanical and electronic systems.
- In-depth training in the use of Ultimaker Cura software, 3D printing.

The distribution of work has been carried out in the following way, taking into account that we live together, the work has practically been done together:

Table 9:Distribution of work

Parts of work	Rober	Sergio
Study of the system		
Calculations		
Detail design		
Design		
Drawings		
Simulations		
Budget		
3D printing		

9 DRAWINGS

Below are attached the drawings that have been extracted through SolidWorks and made in AutoCAD, with the corresponding dimensions of each component of the assembly, being the dimensions based on the ISO-25 standard (metric), helping to establish and comply with the drawing standards, so that at the time of printing the dimensions are maintained.

With respect to the dimensioning, AutoCAD by default places the dimensions horizontally, then, it is decided to follow for the dimensioning the standard UNE 1-039-94 "Dimensioning. General principles, definitions, methods of execution and special indications", where the text alignment is modified, being aligned with dimension line, as shown in the following image:

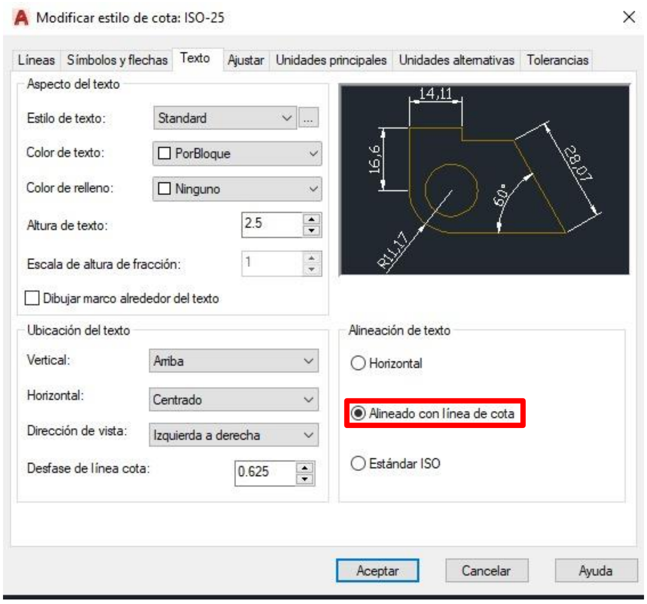


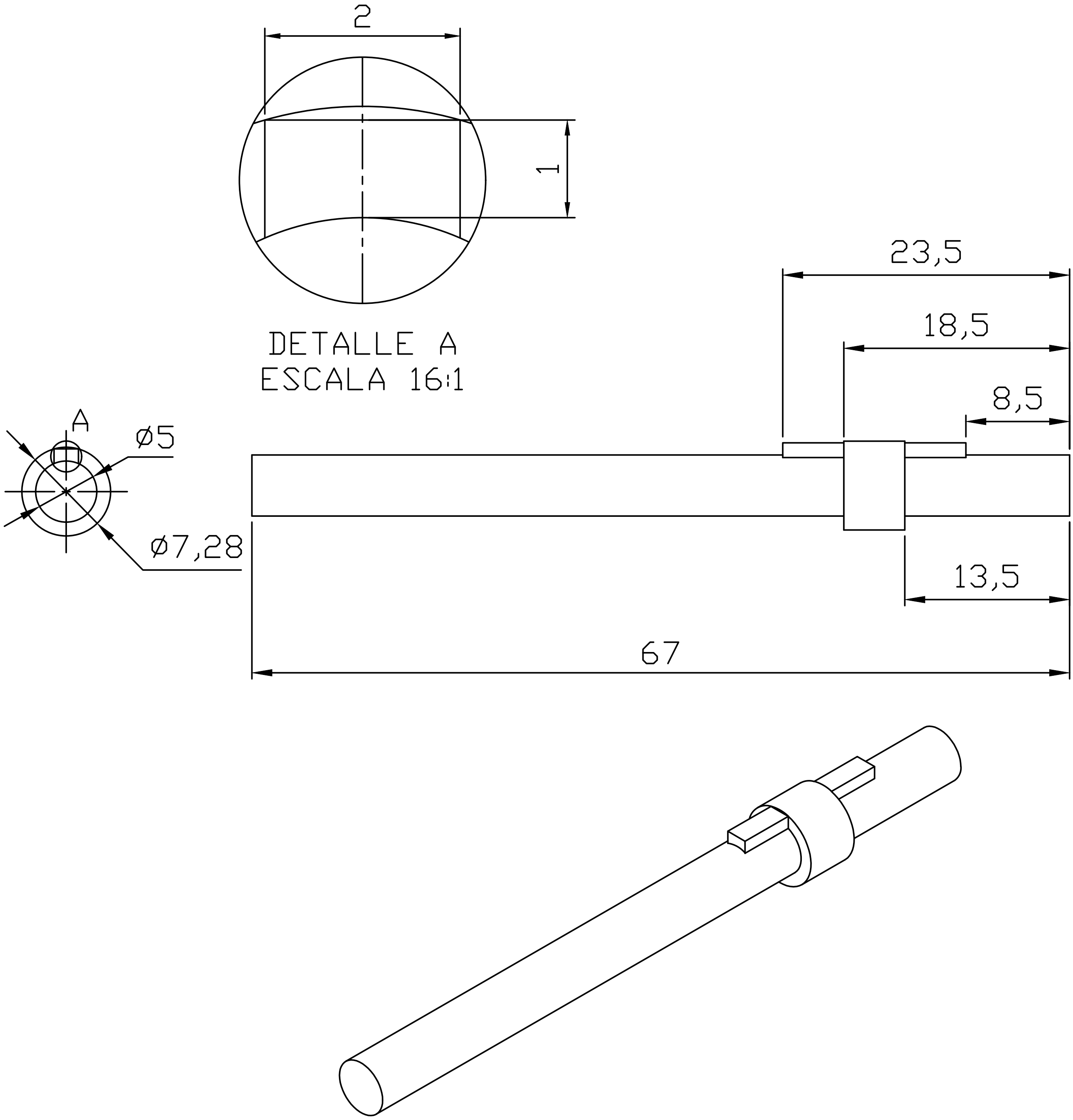
Figure 29: Autocad modifications

Regarding the precision of the measurements, AutoCAD includes by default 2 zeros to the right as decimals, setting it this way, since most of the measurements only have 2 decimals.

With respect to the tolerances, it is decided to disregard them since the drawings are made as a guideline and their purpose is the home 3D printing.

Drawing references shall be made as follows:

- 10XX → Elemental components
- 20XX → Groupings or blocks
- 3001 → Complete System



ITEM	CANT	DESCRIPCION	MATERIAL
001	1	EJE 1	PLA

INGENIERO

Roberto Enríquez Rodríguez
Sergio Moldes Alvarez

REFERENCIA

MODELO A PLA

FECHA

04/01/2022

PROYECTO

PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo

SITUACIÓN: Ubicación del proyecto
Población, Provincia

PLANO

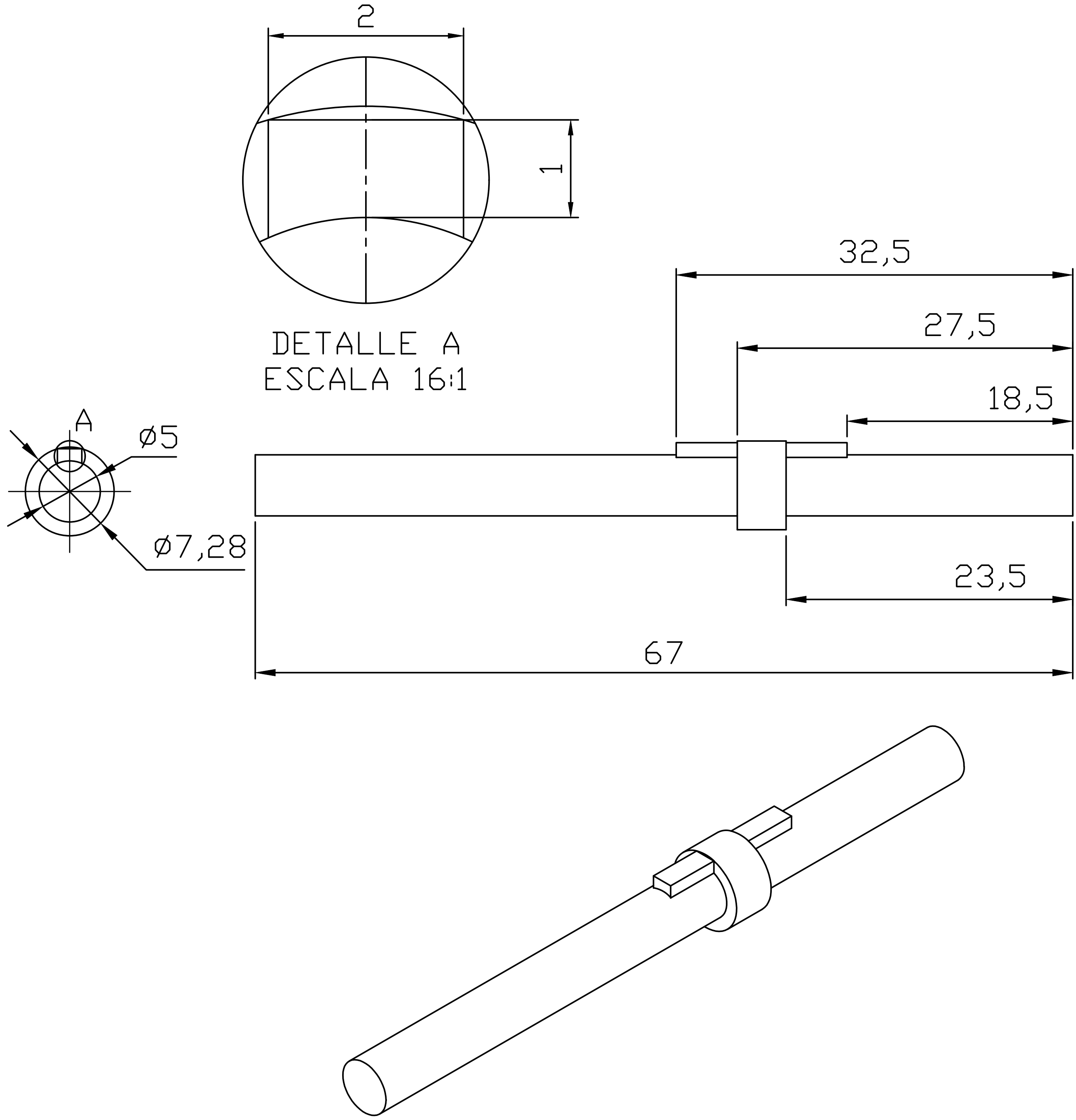
EJE 1

ESCALA

2:1

Nº DE PLANO

1001



ITEM	CANT	DESCRIPCION	MATERIAL
001	1	EJE 2	PLA

INGENIERO

Roberto Enríquez Rodríguez
Sergio Moldes Alvarez

PROYECTO

PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo

SITUACIÓN: Ubicación del proyecto
Población, Provincia

Universida de Vigo

REFERENCIA

MODELO A PLA

PLANO

EJE 2

ESCALA

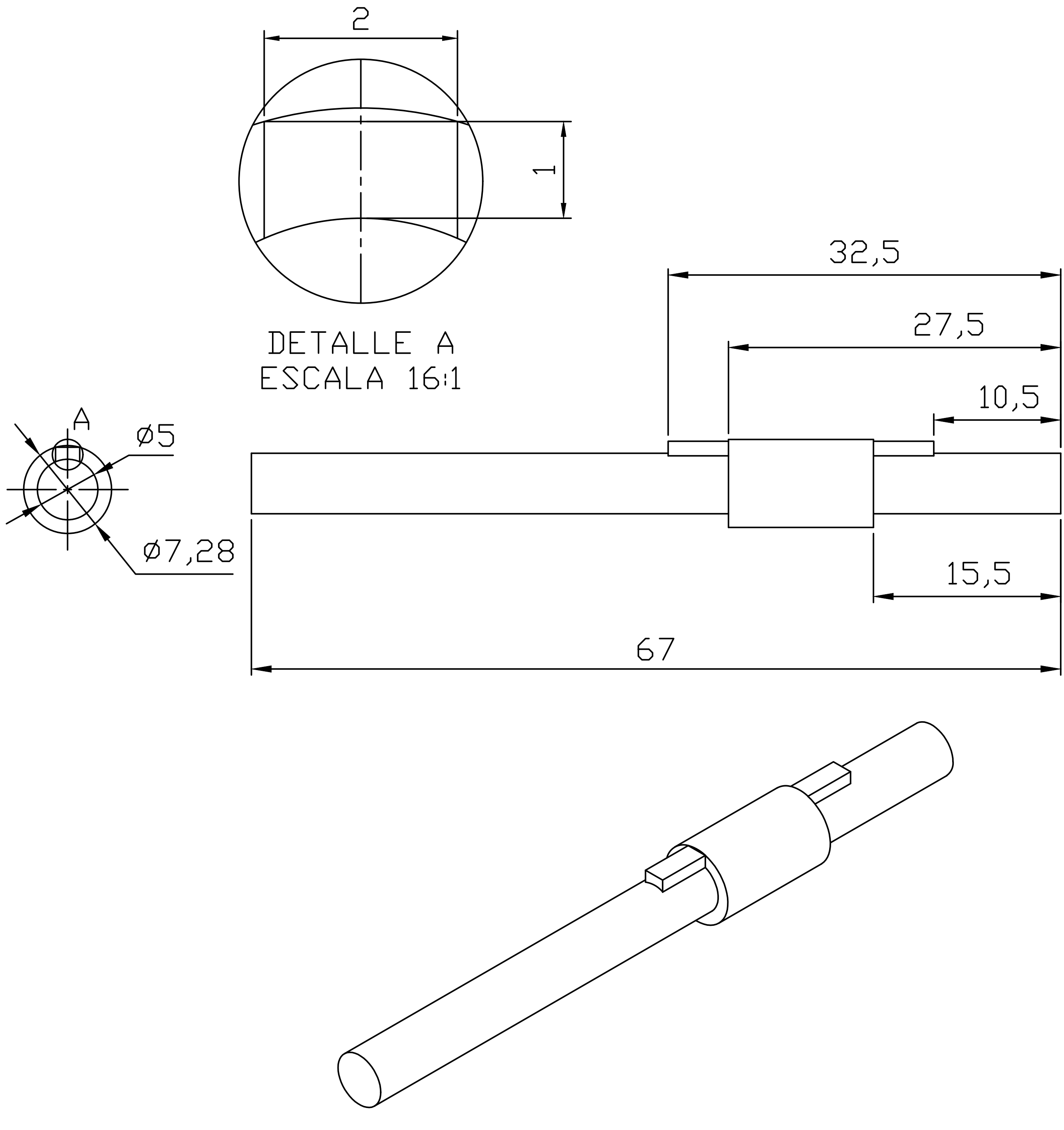
2:1

FECHA

04/01/2022

Nº DE PLANO

1002



ITEM	CANT	DESCRIPCION	MATERIAL
001	1	EJE 3	PLA

INGENIERO

Roberto Enríquez Rodríguez
Sergio Moldes Alvarez

PROYECTO

PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo

SITUACIÓN: Ubicación del proyecto
Población, Provincia

Universida de Vigo

REFERENCIA

MODELO A PLA

PLANO

EJE 3

ESCALA

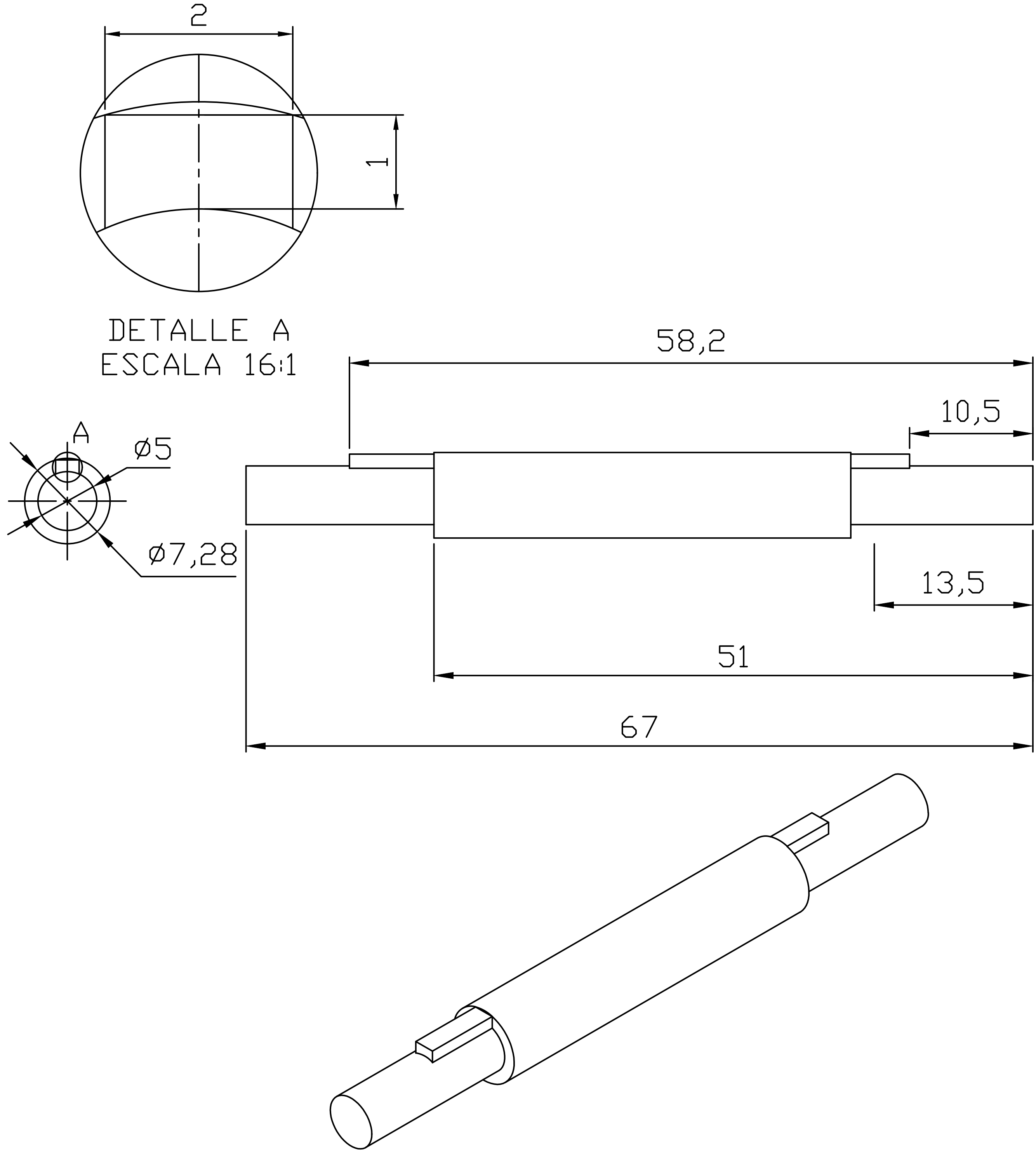
2:1

FECHA

04/01/2022

Nº DE PLANO

1003



ITEM	CANT	DESCRIPCION	MATERIAL
001	1	EJE 4	PLA

INGENIERO

Roberto Enríquez Rodríguez
Sergio Moldes Alvarez

PROYECTO

PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo

SITUACIÓN: Ubicación del proyecto
Población. Provincia

REFERENCIA

MODELO A PLA

PLANO

EJE 4

FECHA

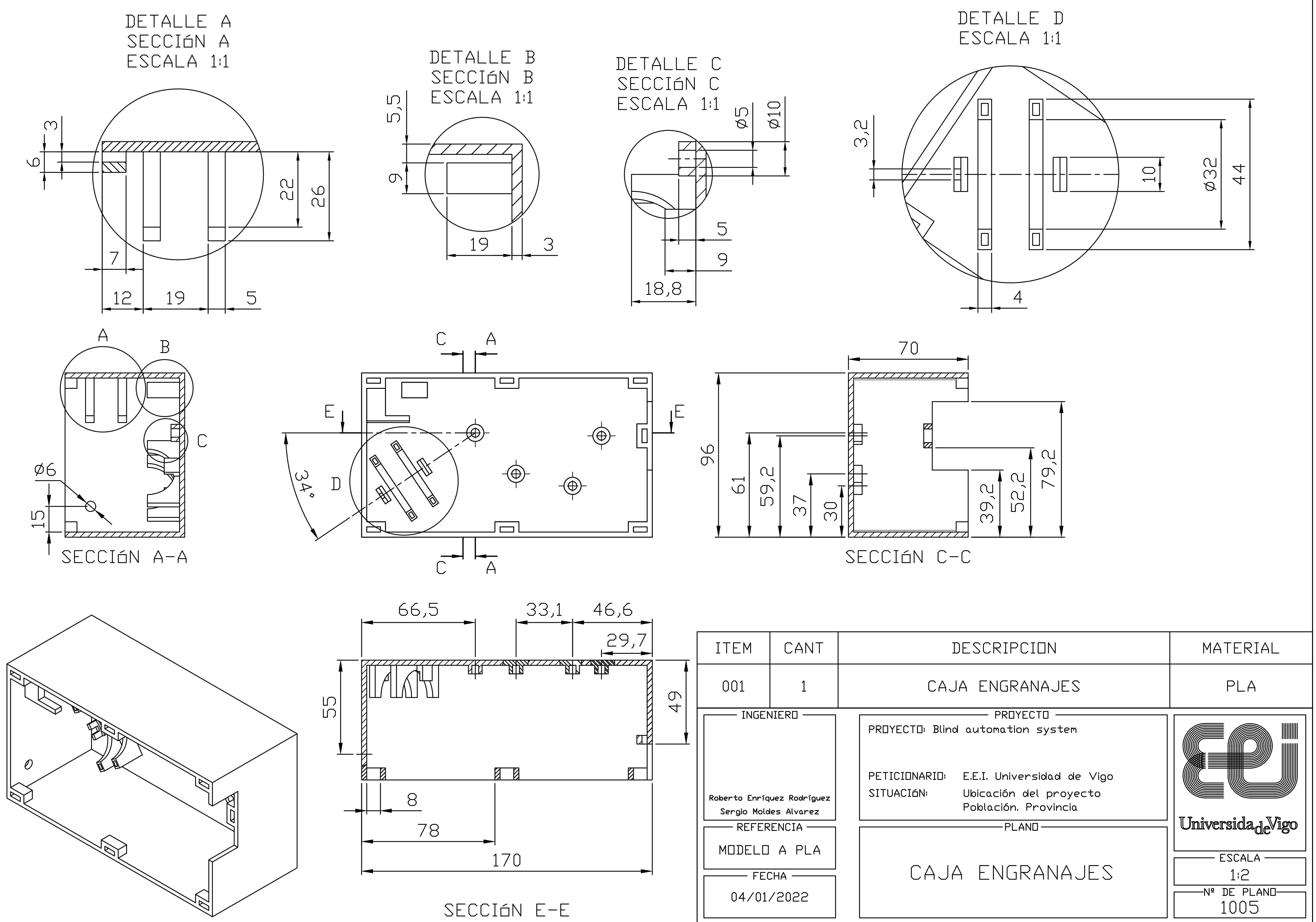
04/01/2022

ESCALA

2:1

Nº DE PLANO

1004



ITEM	CANT	DESCRIPCION	MATERIAL
001	1	CAJA ENGRANAJES	PLA

INGENIERO

Roberto Enríquez Rodríguez
Sergio Moldes Alvarez

PROYECTO

PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo
SITUACIÓN: Ubicación del proyecto
Población. Provincia

REFERENCIA

MODELO A PLA

PLANO

CAJA ENGRANAJES

FECHA

04/01/2022

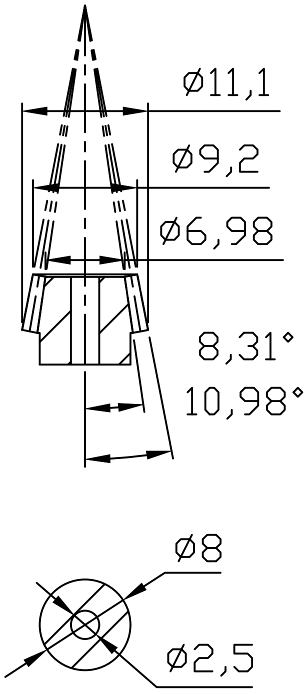
ESCALA

1:2

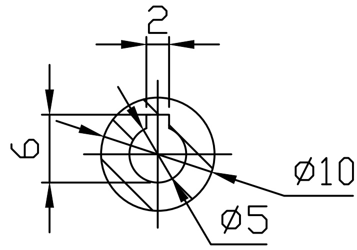
Nº DE PLANO

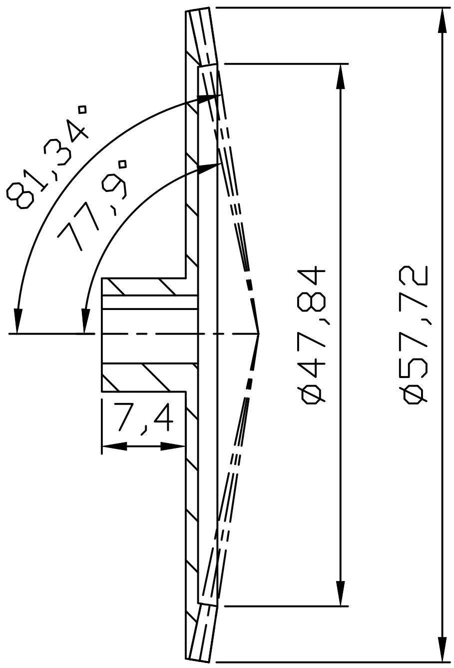
1005

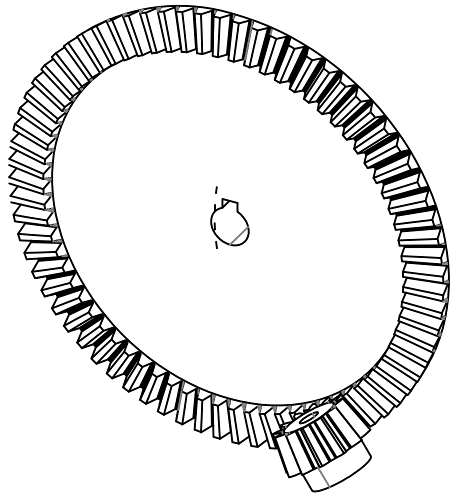
ITEM 001



ITEM 002







ITEM	CANT	DESCRIPCION	MATERIAL
001	1	ENGRANAJE CÓNICO PIÑÓN (Z=12)	PLA
002	1	ENGRANAJE CÓNICO ENGRANAJE (Z=72)	PLA

INGENIERO

Roberto Enríquez Rodríguez
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PROYECTO

PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo
SITUACIÓN: Ubicación del proyecto
Población, Provincia

Universida de Vigo

REFERENCIA

MODELO A PLA

PLANO

ENGRANAJE 1-2

FECHA

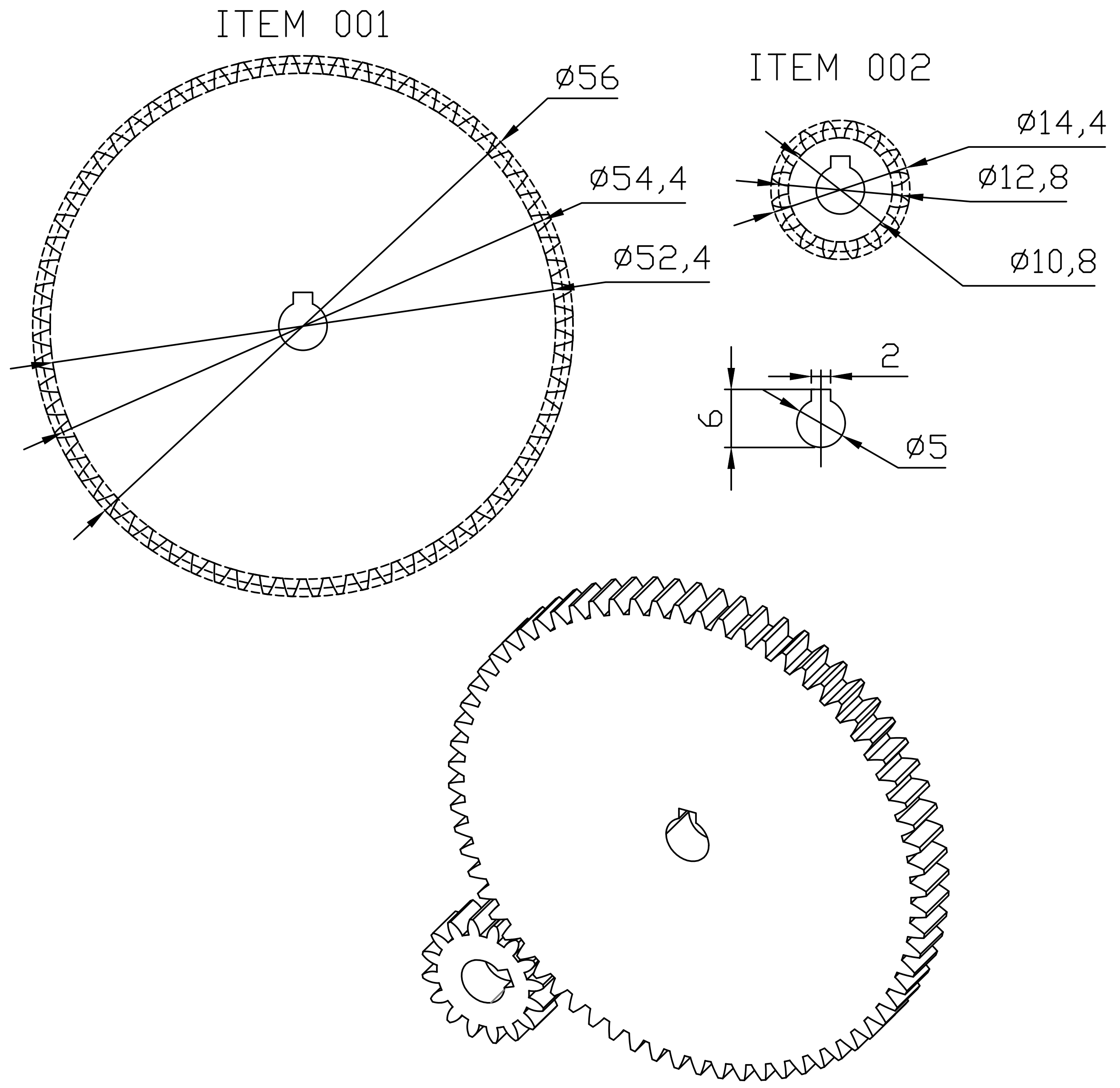
04/01/2022

ESCALA

1.5:1

Nº DE PLANO

1006



ITEM	CANT	DESCRIPCION	MATERIAL
001	1	ENGRANAJE RECTO (Z=68, e=5mm)	PLA
002	1	ENGRANAJE RECTO (Z=16, e=5mm)	PLA

INGENIERO

Roberto Enríquez Rodríguez
Sergio Moldes Alvarez

PROYECTO

PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo
SITUACIÓN: Ubicación del proyecto
Población, Provincia

Universida de Vigo

REFERENCIA

MODELO A PLA

FECHA

04/01/2022

PLANO

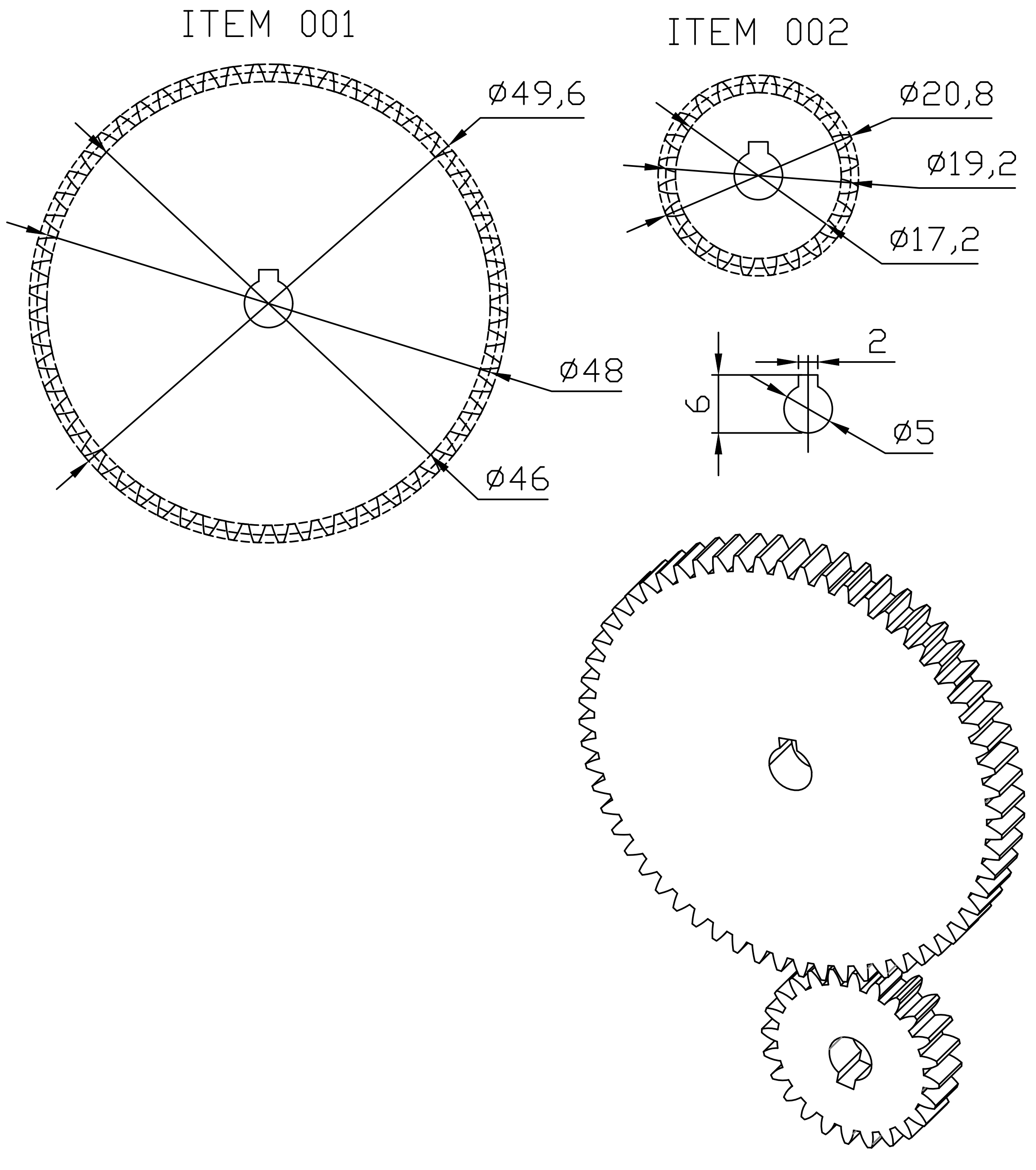
ENGRANAJE 3-4

ESCALA

1.5:1

Nº DE PLANO

1007



ITEM	CANT	DESCRIPCION	MATERIAL
001	1	ENGRANAJE RECTO (Z=60, e=5mm)	PLA
002	1	ENGRANAJE RECTO (Z=24, e=5mm)	PLA

INGENIERO

Roberto Enríquez Rodríguez
Sergio Moldes Alvarez

PROYECTO

PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo
SITUACIÓN: Ubicación del proyecto
Población, Provincia

Universida de Vigo

REFERENCIA

MODELO A PLA

PLANO

ENGRANAJE 5-6

FECHA

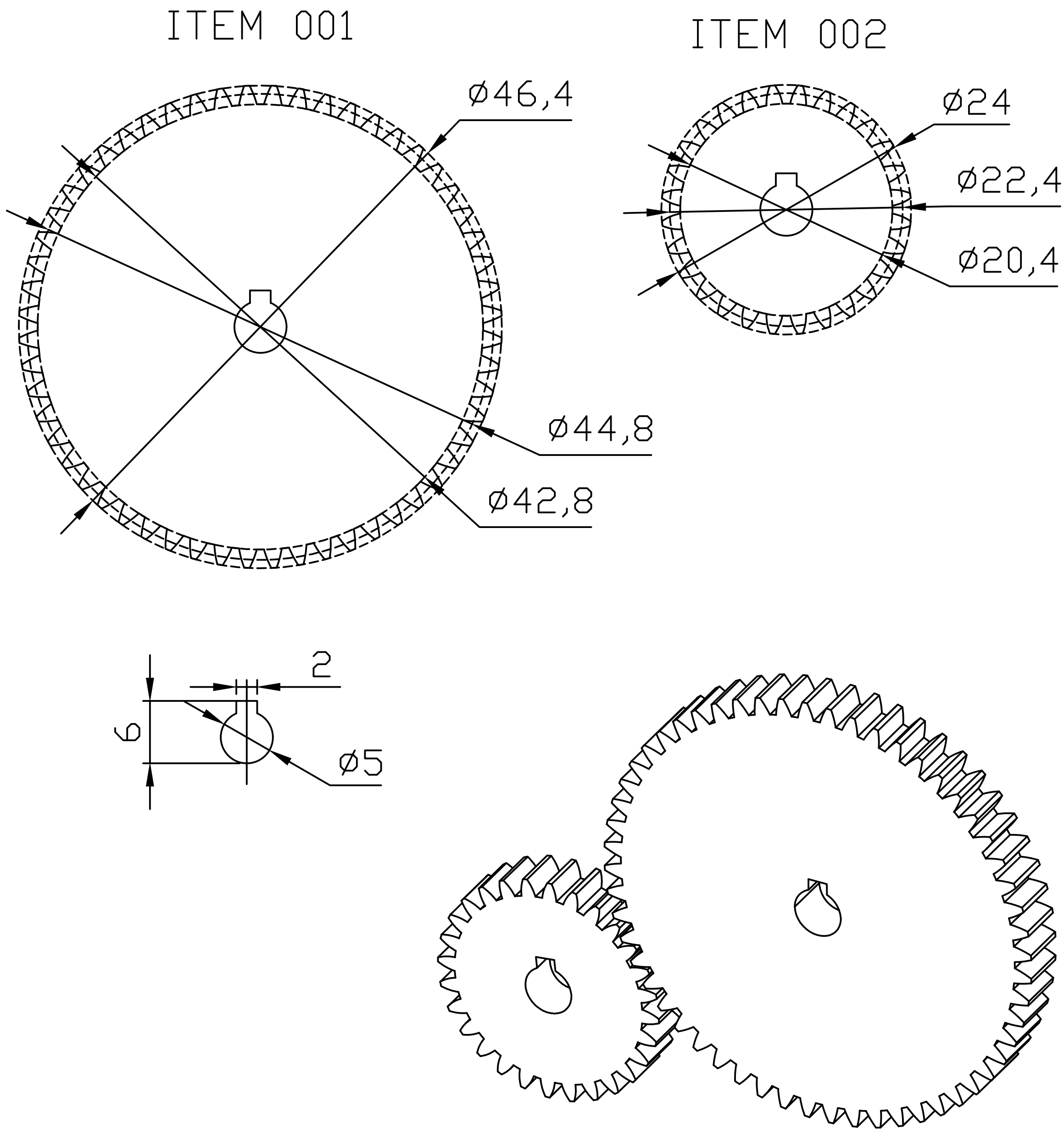
04/01/2022

ESCALA

1.5:1

Nº DE PLANO

1008



ITEM	CANT	DESCRIPCION	MATERIAL
001	1	ENGRANAJE RECTO (Z=56, e=5mm)	PLA
002	1	ENGRANAJE RECTO (Z=28, e=5mm)	PLA

INGENIERO
Roberto Enríquez Rodríguez
Sergio Moldes Alvarez

PROYECTO
PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo
SITUACIÓN: Ubicación del proyecto
Población, Provincia

Universida de Vigo

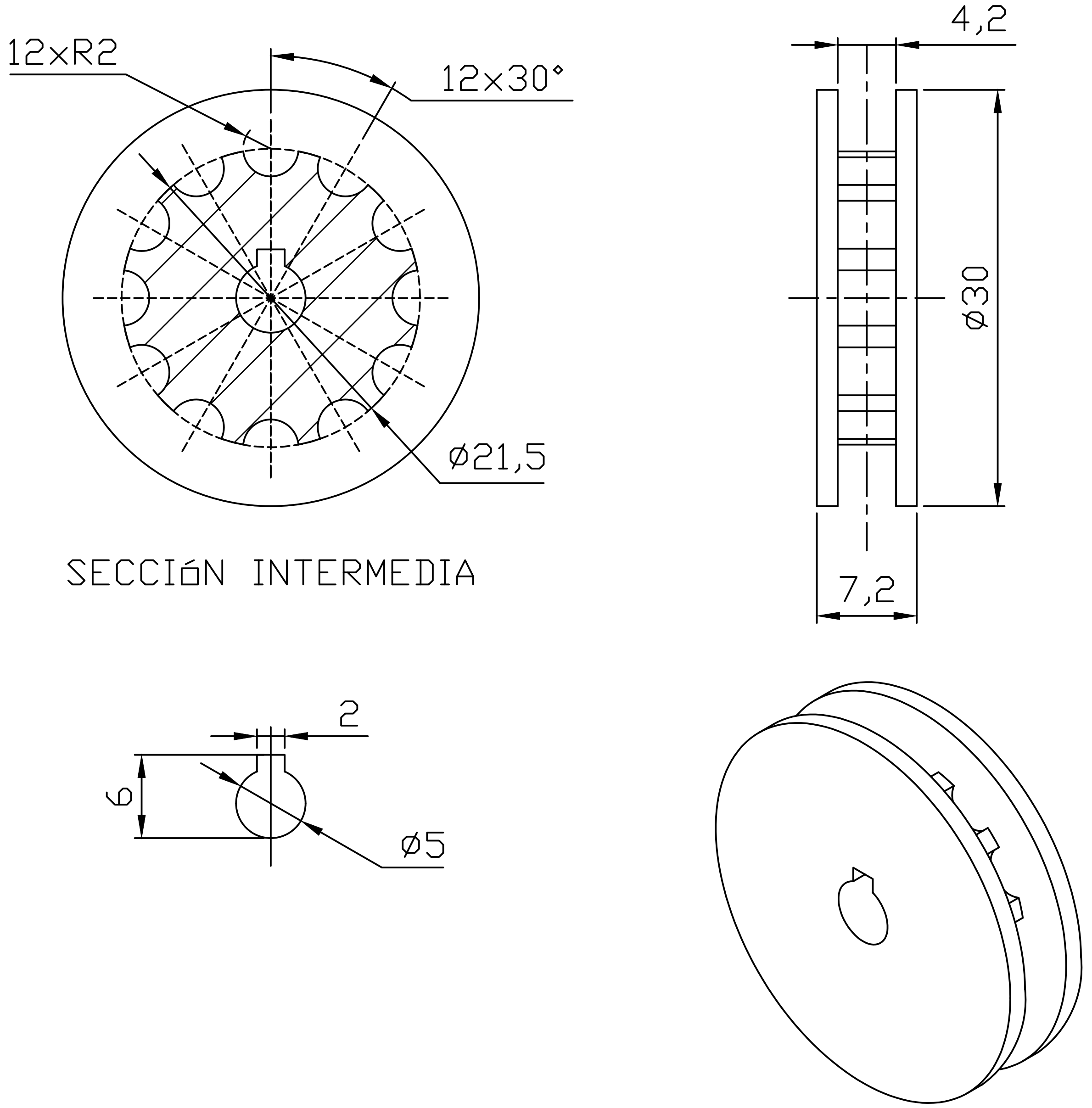
REFERENCIA
MODELO A PLA

PLANO
ENGRANAJE 7-8

FECHA
04/01/2022

ESCALA
1.5:1

Nº DE PLANO
1009



ITEM	CANT	DESCRIPCION	MATERIAL
001	1	POLEA CORTINA	PLA

INGENIERO

Roberto Enríquez Rodríguez
Sergio Moldes Alvarez

PROYECTO

PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo
SITUACIÓN: Ubicación del proyecto
Población, Provincia

REFERENCIA

MODELO A PLA

PLANO

POLEA CORTINA

FECHA

04/01/2022

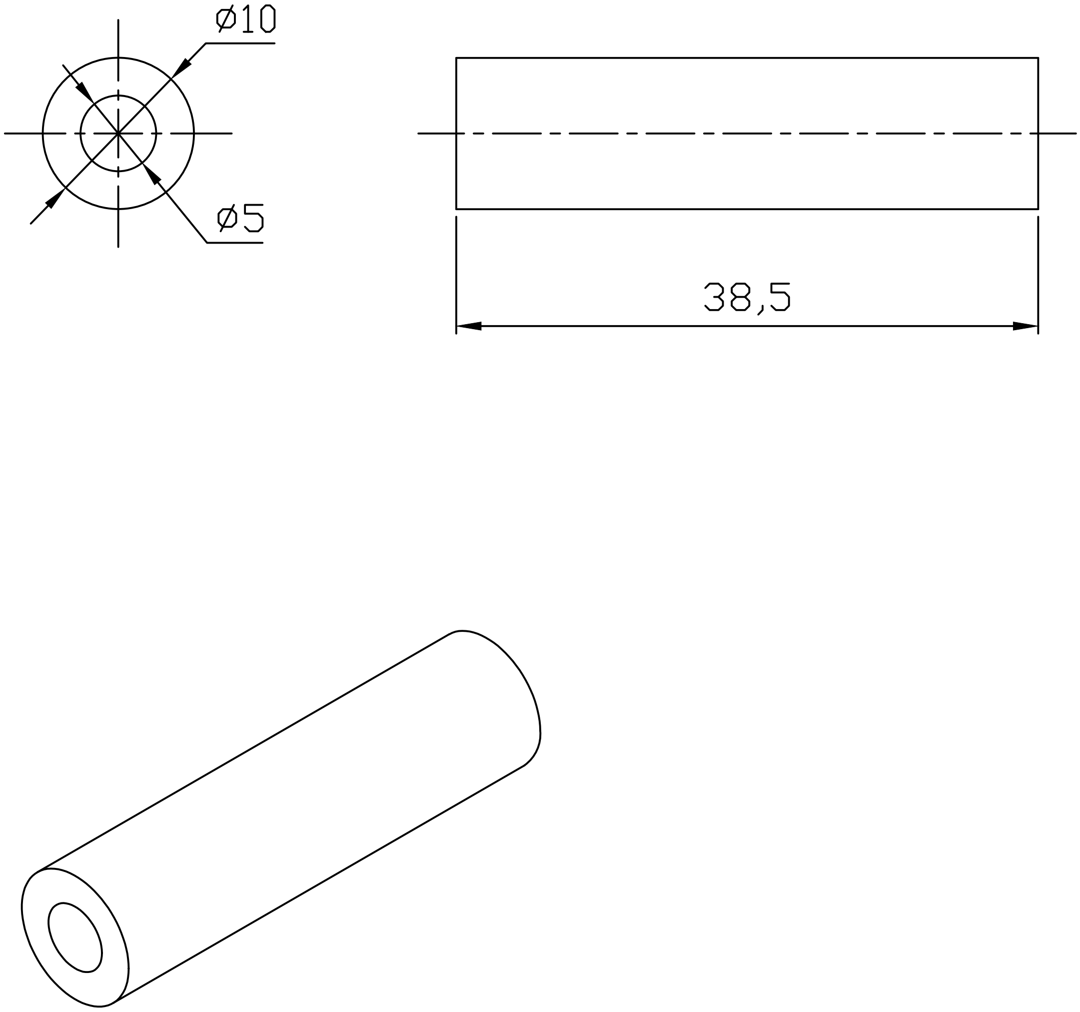
Universida de Vigo

ESCALA

2:1

Nº DE PLANO

1010



ITEM	CANT	DESCRIPCION	MATERIAL
001	1	SOPORTE 38.5	PLA

INGENIERO

Roberto Enríquez Rodríguez
Sergio Moldes Alvarez

PROYECTO

PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo
SITUACIÓN: Ubicación del proyecto
Población, Provincia

Universida de Vigo

REFERENCIA

MODELO A PLA

PLANO

SOPORTE 38.5

FECHA

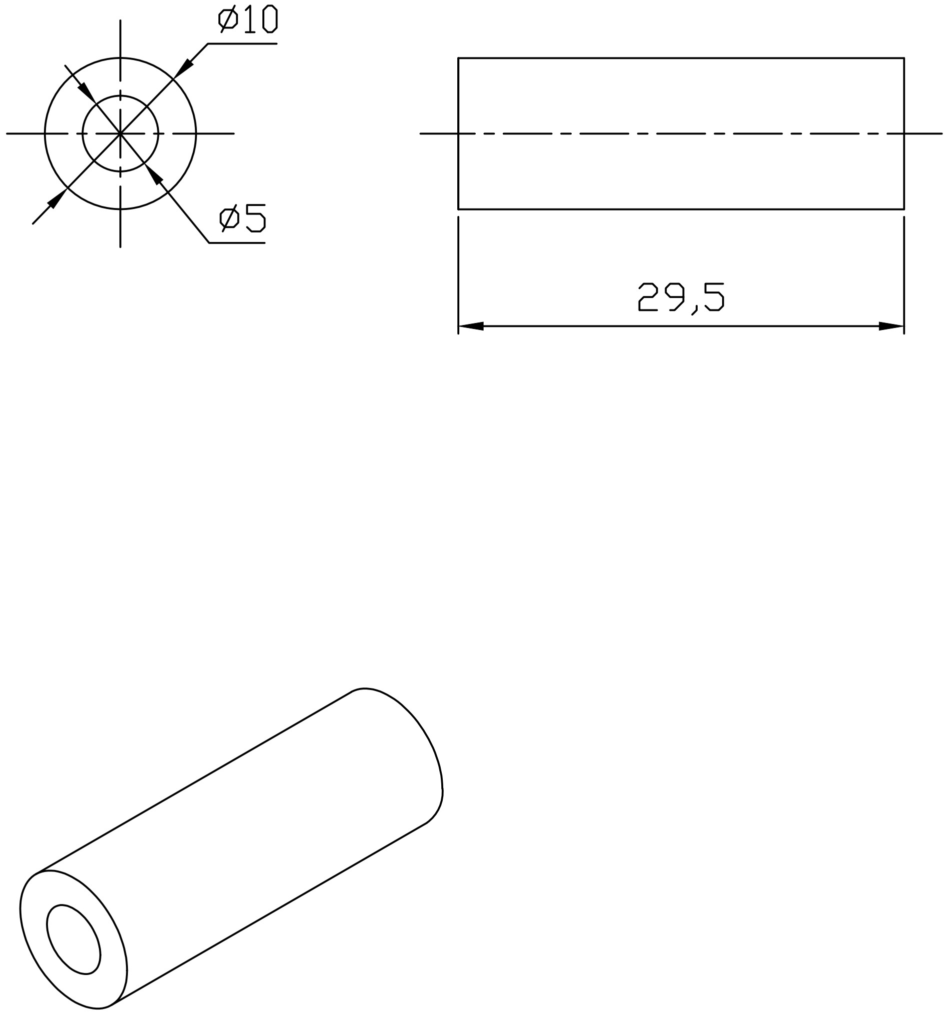
04/01/2022

ESCALA

2:1

Nº DE PLANO

1011



ITEM	CANT	DESCRIPCION	MATERIAL
001	1	SOPORTE 29.5	PLA

INGENIERO

Roberto Enríquez Rodríguez
Sergio Moldes Alvarez

PROYECTO

PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo

SITUACIÓN: Ubicación del proyecto
Población, Provincia

Universida de Vigo

REFERENCIA

MODELO A PLA

PLANO

SOPORTE 29.5

ESCALA

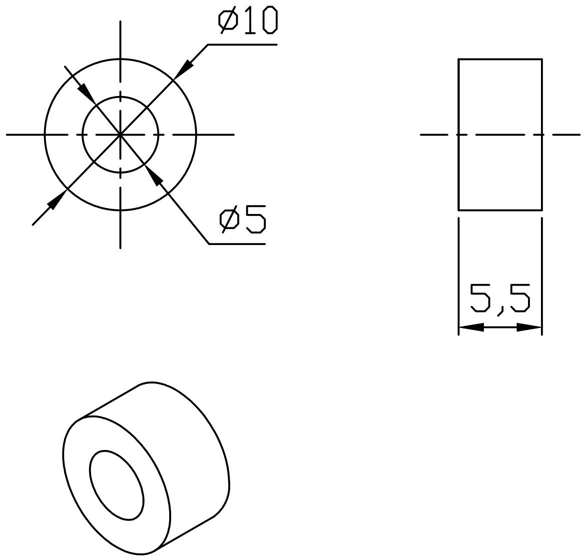
2:1

FECHA

04/01/2022

Nº DE PLANO

1012



ITEM	CANT	DESCRIPCION	MATERIAL
001	1	SOPORTE 5.5	PLA

INGENIERO

Roberto Enríquez Rodríguez
Sergio Moldes Alvarez

PROYECTO

PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo
SITUACIÓN: Ubicación del proyecto
Población. Provincia

Universida de Vigo

REFERENCIA

MODELO A PLA

PLANO

SOPORTE 5.5

FECHA

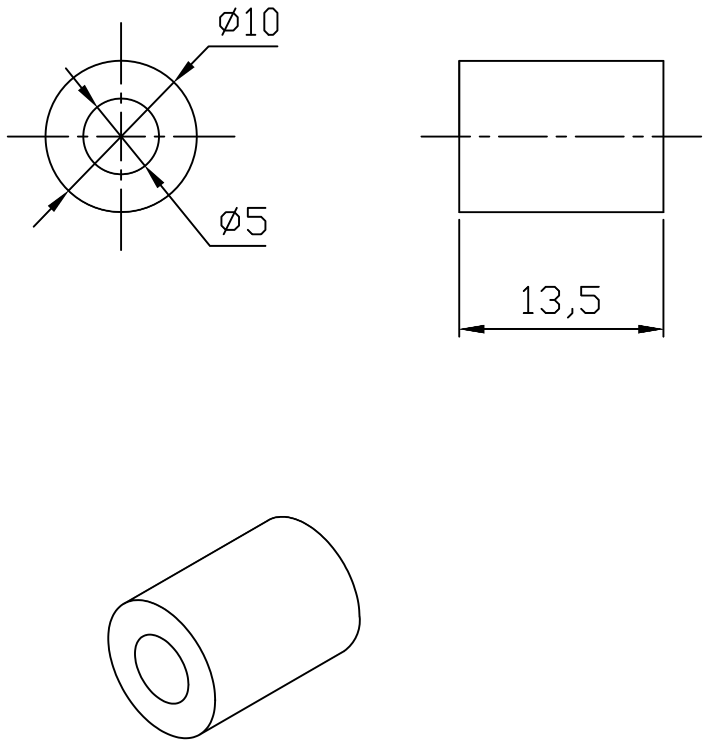
04/01/2022

ESCALA

2:1

Nº DE PLANO

1013



ITEM	CANT	DESCRIPCION	MATERIAL
001	1	SOPORTE 13.5	PLA

INGENIERO

Roberto Enríquez Rodríguez
Sergio Moldes Alvarez

PROYECTO

PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo
SITUACIÓN: Ubicación del proyecto
Población, Provincia

Universidade Vigo

REFERENCIA

MODELO A PLA

PLANO

SOPORTE 13.5

ESCALA

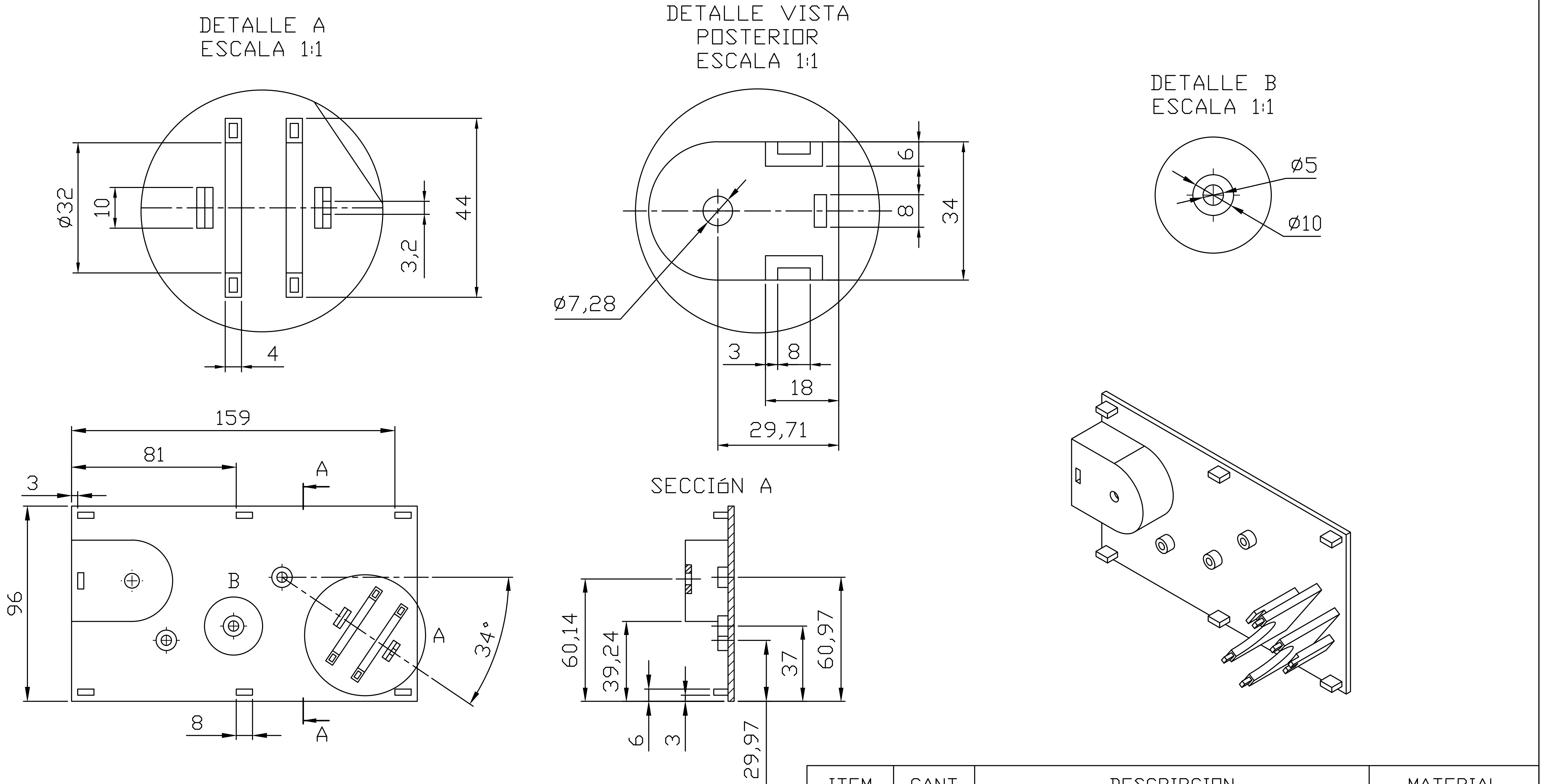
2:1

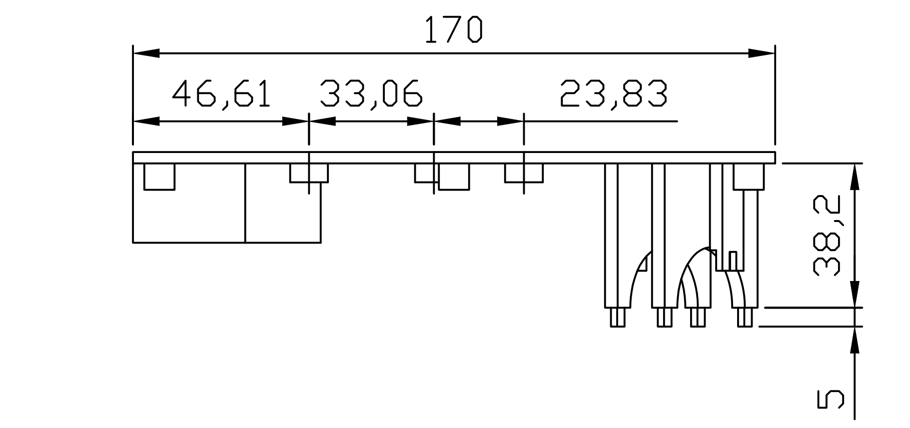
FECHA

04/01/2022

Nº DE PLANO

1014





ITEM	CANT	DESCRIPCION	MATERIAL
001	1	TAPA ENGRANAJES	PLA

INGENIERO

Roberto Enríquez Rodríguez
Sergio Moldes Alvarez

PROYECTO

PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo
SITUACIÓN: Ubicación del proyecto
Población. Provincia

REFERENCIA
MODELO A PLA

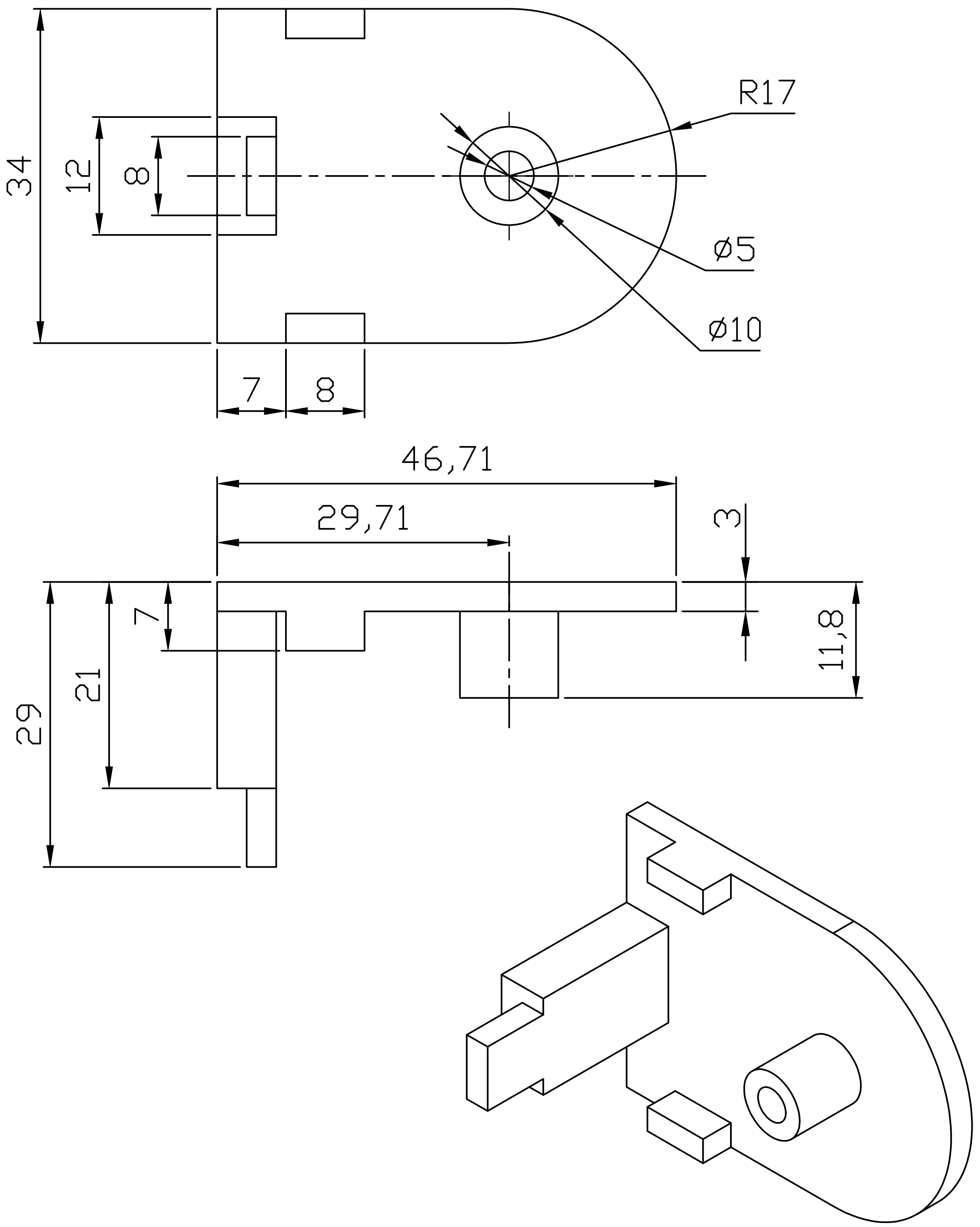
FECHA
04/01/2022

PLANO
TAPA ENGRANAJES

Universida de Vigo

ESCALA
1:2

Nº DE PLANO
1015



ITEM	CANT	DESCRIPCION	MATERIAL
001	1	TAPA POLEA CORTINA	PLA

INGENIERO

Roberto Enríquez Rodríguez
Sergio Moldes Alvarez

PROYECTO

PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo

SITUACIÓN: Ubicación del proyecto
Población, Provincia

Universida de Vigo

REFERENCIA

MODELO A PLA

FECHA

04/01/2022

PLANO

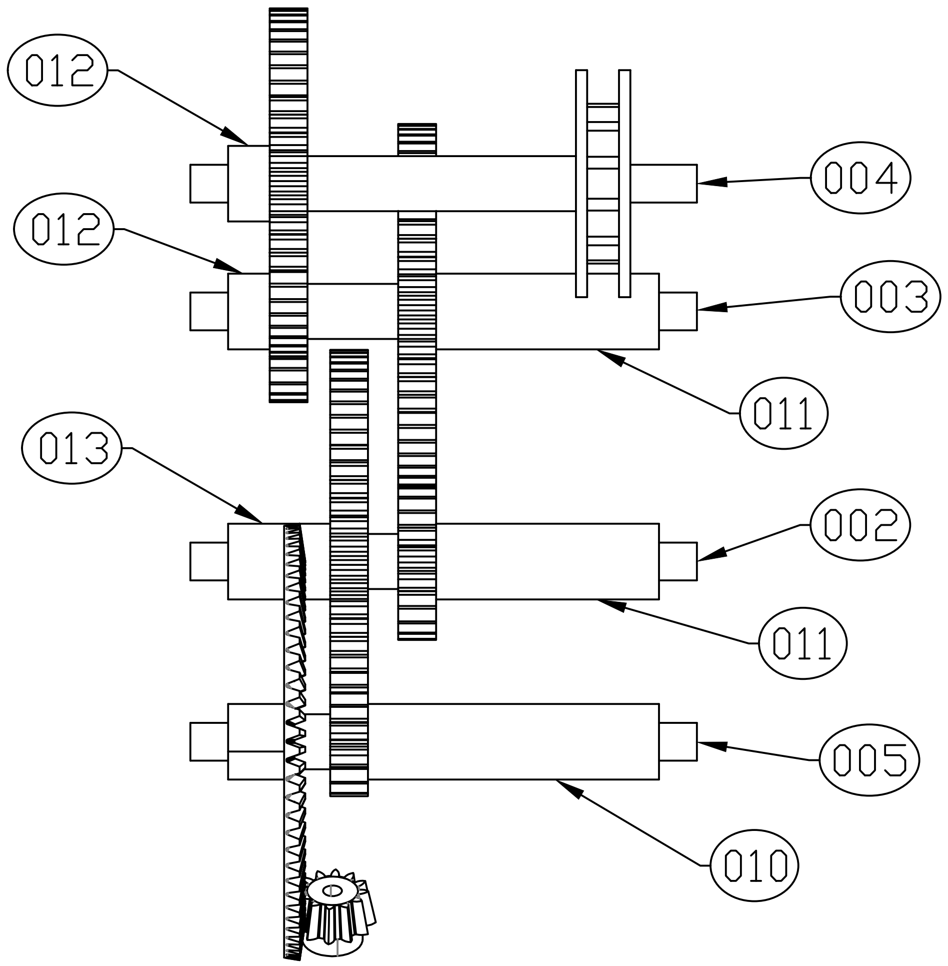
TAPA POLEA CORTINA

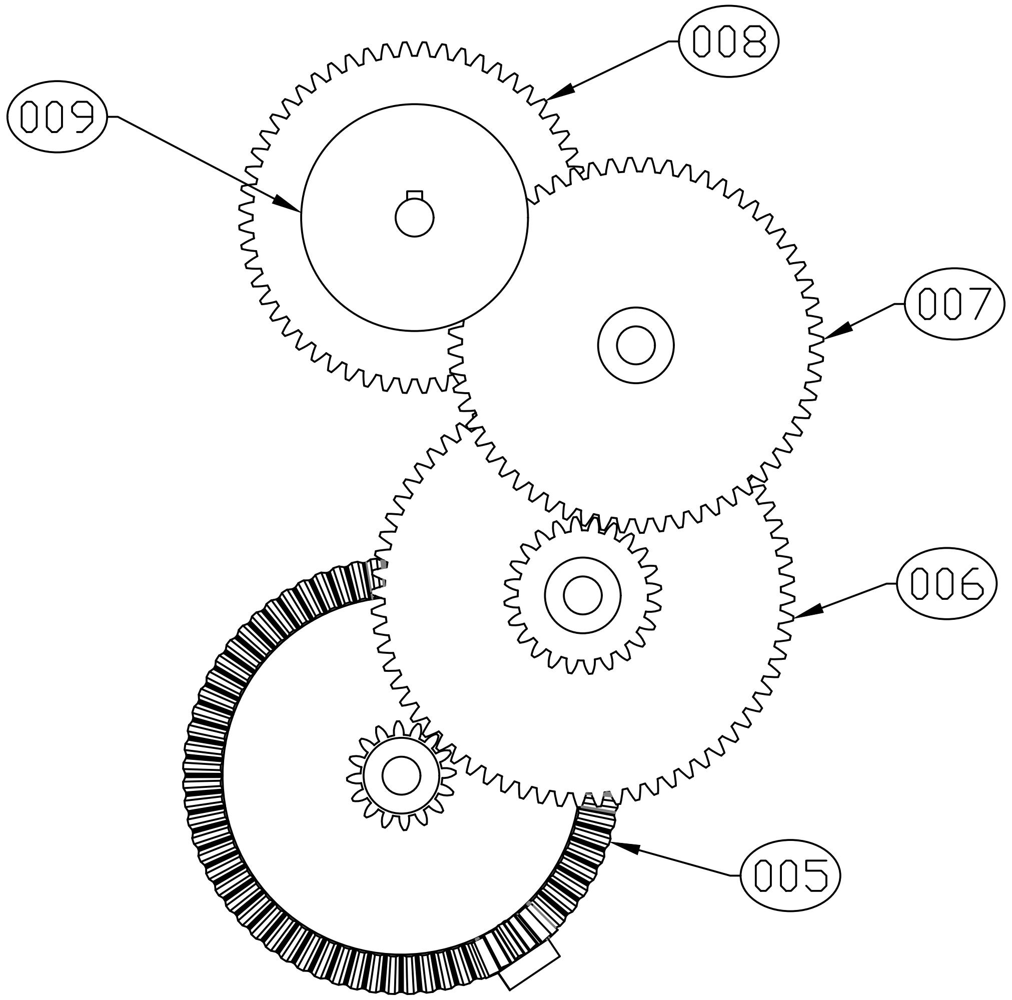
ESCALA

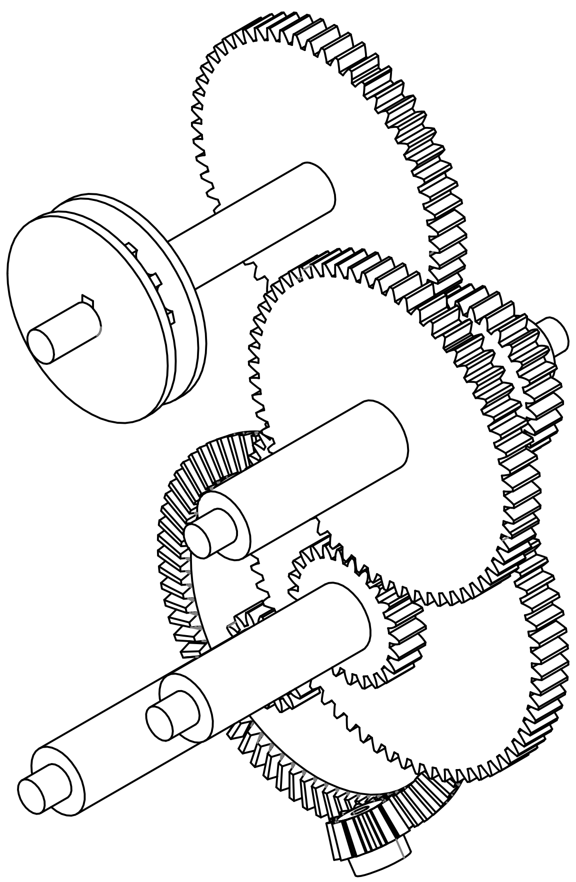
1.5:1

Nº DE PLANO

1016







ITEM	CANT	DESCRIPCION	PLANO
001	1	Eje 1 PLA	1001
002	1	Eje 2 PLA	1002
003	1	Eje 3 PLA	1003
004	1	Eje 4 PLA	1004
005	1	Engranaje 1-2	1006
006	1	Engranaje 3-4	1007
007	1	Engranaje 5-6	1008
008	1	Engranaje 7-8	1009
009	1	Polea cortina	1010
010	1	Soporte 38.5	1011
011	2	Soporte 29.5	1012
012	2	Soporte 5.5	1013
013	1	Soporte 13.5	1014

INGENIERO

Roberto Enríquez Rodríguez
Sergio Moldes Alvarez

REFERENCIA

MODELO A PLA

FECHA

04/01/2022

PROYECTO

PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo

SITUACIÓN: Ubicación del proyecto
Población. Provincia

PLANO

TREN DE ENGRANAJES

Universida de Vigo

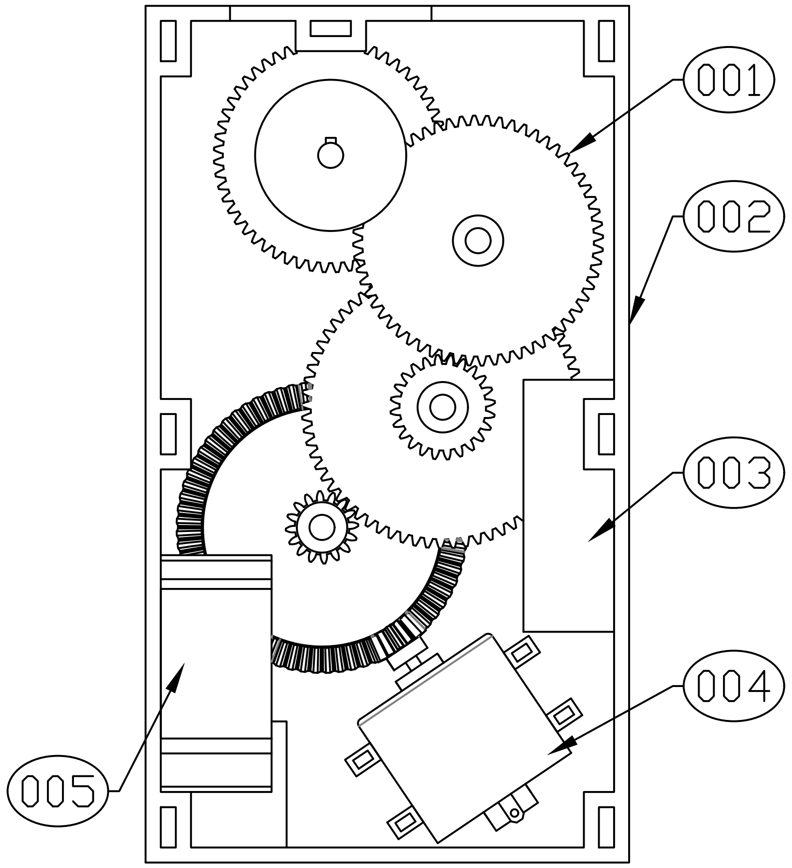
ESCALA

1:1

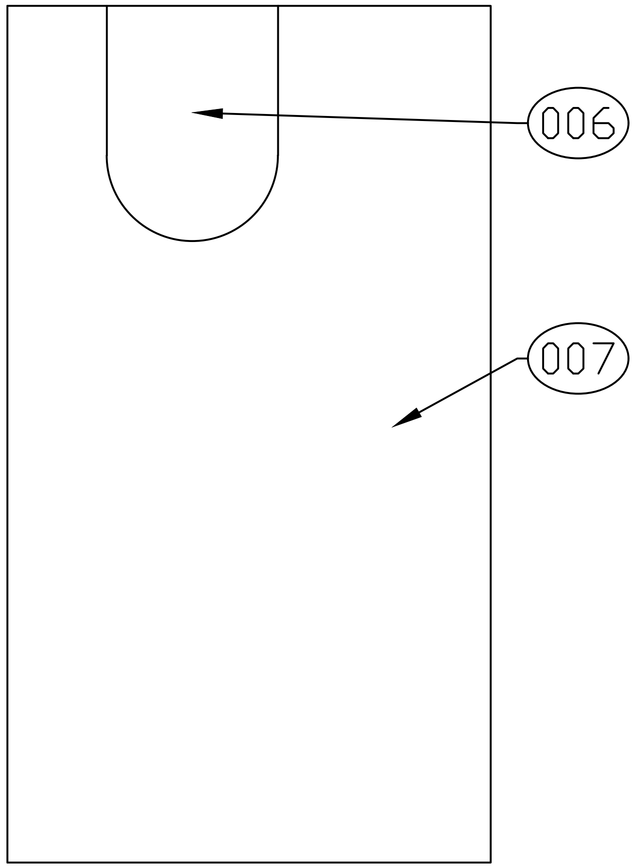
Nº DE PLANO

2001

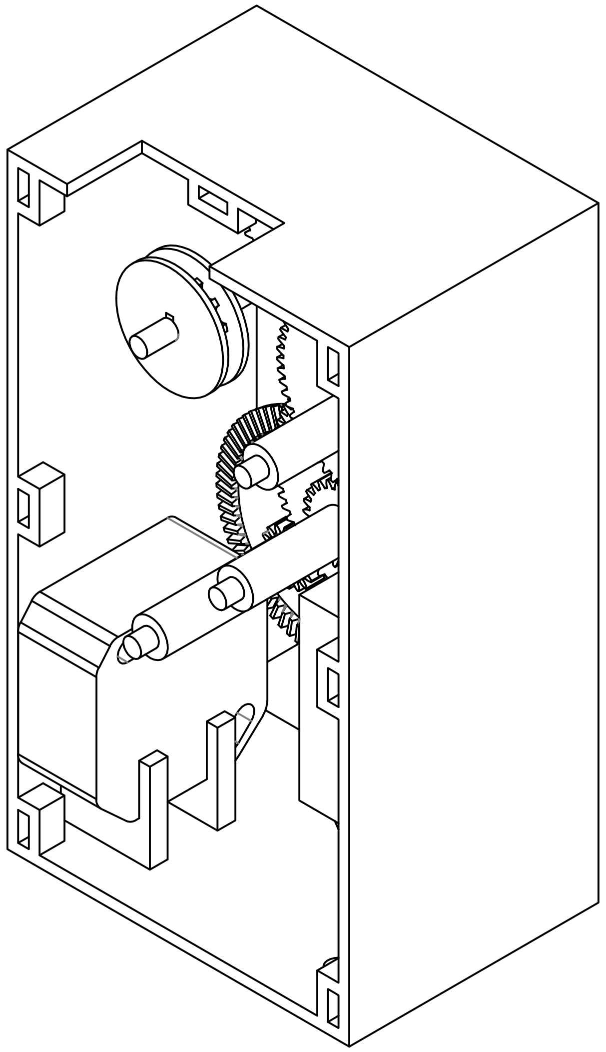
ENSAMBLAJE SIN TAPA

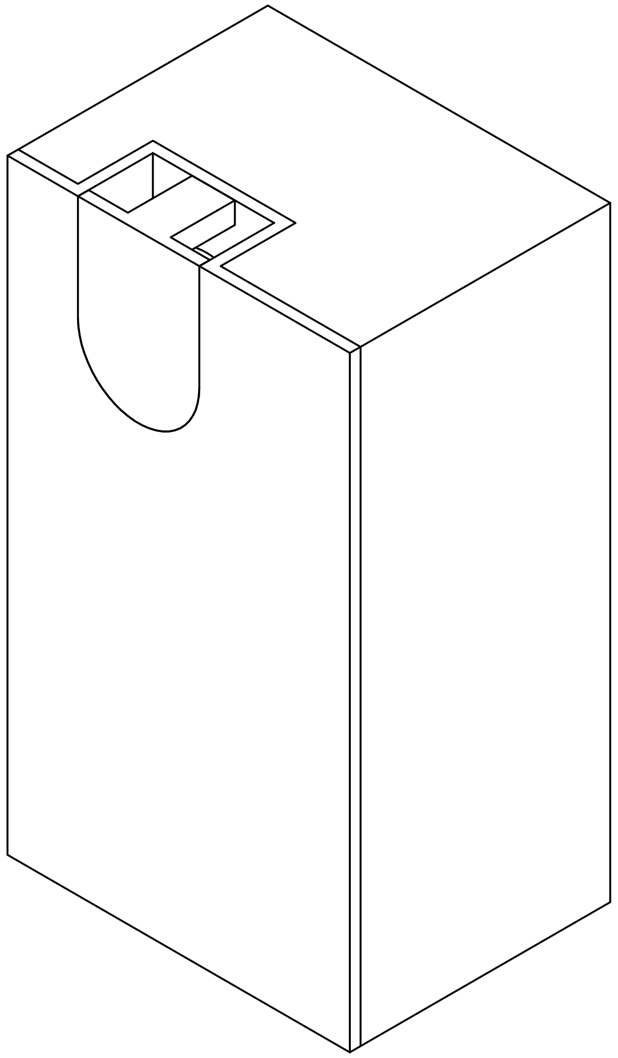


ENSAMBLAJE COMPLETO



ITEM	CANT	DESCRIPCION	PLANO
001	1	Tren de engranajes	2001
002	1	Caja engranajes	1005
003	1	Transformador	Comercial
004	1	Motor	Comercial
005	1	Conmutador	Comercial
006	1	Tapa engranajes	1015
007	1	Tapa polea	1016





INGENIERO

Roberto Enríquez Rodríguez
Sergio Moldes Alvarez

PROYECTO

PROYECTO: Blind automation system

PETICIONARIO: E.E.I. Universidad de Vigo

SITUACIÓN: Ubicación del proyecto
Población. Provincia

Universida de Vigo

REFERENCIA

MODELO A PLA

PLANO

ENSAMBLAJE COMPLETO

FECHA

04/01/2022

ESCALA

1:1.5

Nº DE PLANO

3001