



# *Designing of a holder for a ESI-source experiment*

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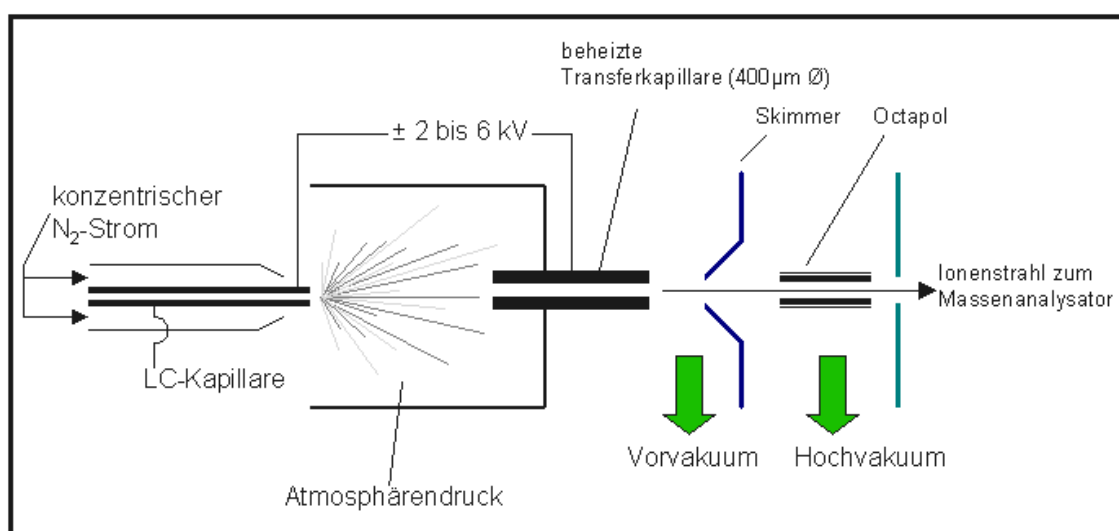
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## **1. Introduction and theoretical background.**

The project I have been working on is related with the electrospray ionization (ESI) methods which allow the research into different problems such as the interaction of biomolecules with surfaces in a controlled environment. All these situation should be accomplished in specific thermal and physicochemical conditions in general, being able to change different parameters in a easy way.

In order to make this up, it is used a ultra high vacuum (UHV) chamber as deposition environment and the charged particles are introduced into this device through a ESI-needle that is placed in front of a thin capillary (without a complet contact), using a potential difference to overcome the close barrier (only a few millimeters) separating capillary and needle, as can be observed in Figure 1.1.



**Figure 1.1:** Schematic drawing of the ESI-deposition circuit.

Actually the ESI is used as a beam source that has to be held with some kind of stable solid device to be able to focus the capillary vacuum chamber without any fluctuation due to the possible unstable shakes of the needle.

The aim of this project is studying the requirements and measurements which this holder has to be constructed with and design different parts to assembly using the software Solid Edge ST3. So the main tools that I have been using are a caliber and SEST3. Finally, we should be able to test the stability and performance of the assembly setup.

## **2. Requirements and measurements.**

### ***2.1. General requirements.***

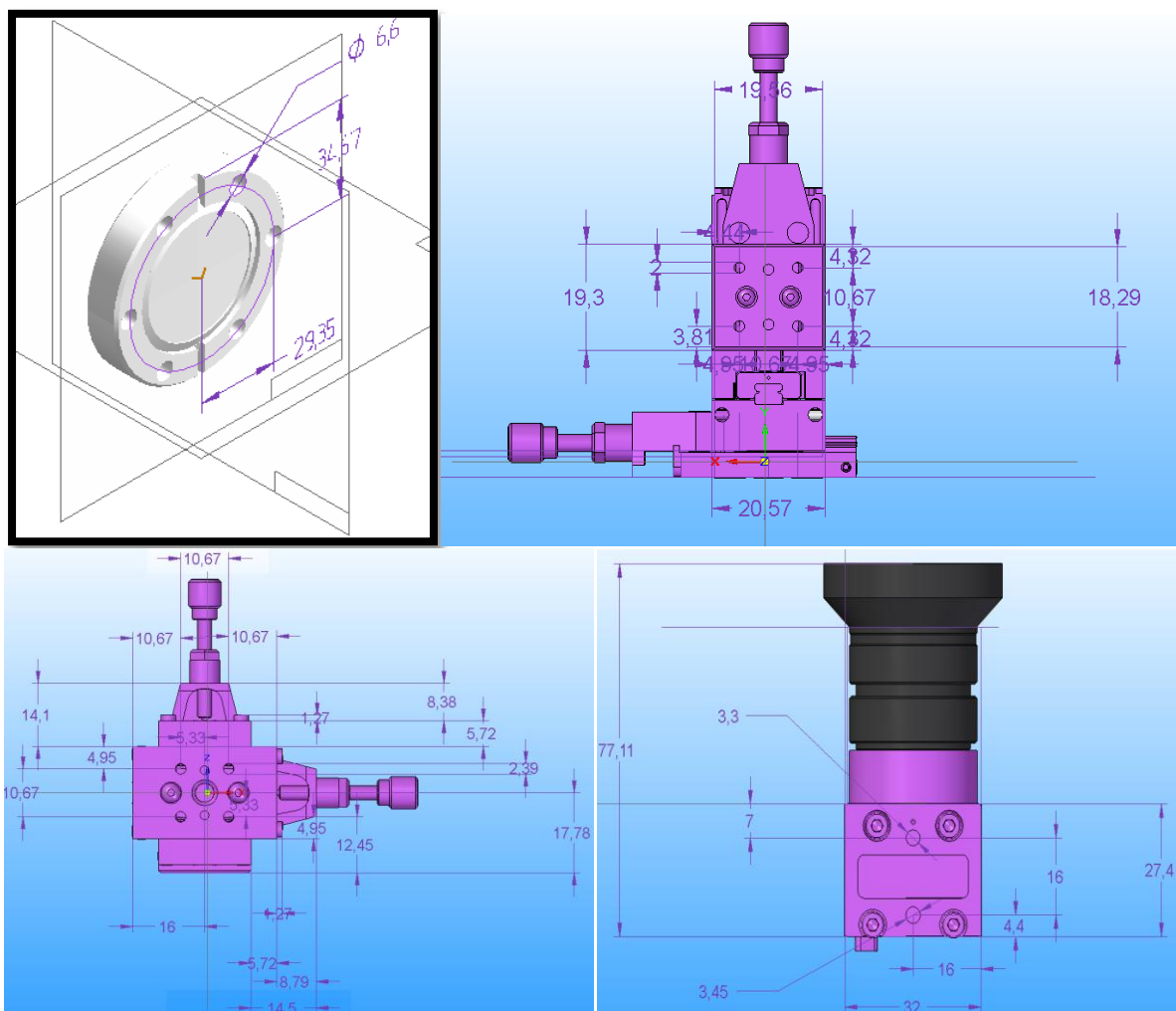
In this section, it is analyzed the optimum way to design the different pieces so as how many are necessary and the size of each. Both the geometry of the already existent flange in the vacuum chamber where our device will be fitted and the length of the capillary, which connects the emitter with the center of the flange, and the ESI-needle are the two most important general requirements we have to look at. Other previous devices we have to consider are a traslation stage (placed in the hypothetical basis of the unborn new holder) to carry the ESI-emitter and a CCD camera which will be placed somehow (fitted in the new device) over the small distance of 2-3 millimeters separating both emitter and capillary in order to research about the ESI process. Then, the main goal is the conception of a assembly of different pieces to hold any other necessary device (flange, capillary, ESI-needle) in the right place.

Likewise, the stability is the other key factor that needs to be considered, so it was decided to construct a lateral part which is fixed into the flange (we can check the figure 2.1.), a basis which carries the translation stage and will add two reinforcements in both sides.



**Figure 2.1:** Initial conditions for the setup. In the left picture, it is possible to observe the previous unstable holder which will be replaced and the conetion between the capllary and the ESI-source (needle). In the right side of the page we can perceive the geometric restriction because of the position of the flange where our device should be fixed.

In the next complex figure we can check the measurements of the different pieces implicated, in order to check our size elections in the design. It makes no sense to explain talk about every measurement, so these photos will be our main work to check de doubts. All the specified data are in the Solid Edge files for a deeper analysis.



**Figure 2.2:** Measurements of different devices involved in the design of our holder. A) Flange (fit of the complete holder through the lateral part). B) Frontal view of the traslation stage (choice of the hight for the lateral part and the ESI-needle). C) Basis of the traslation stage (important in the election of the width for the basis part). D) CCD camera (the key for the length of the lateral part -the part screwed on the flange-, fixed over the conexion needle-capillary).

## **2.2. *Specific requirements.***

The most specific parts are the lateral and the basis. Some easy requirements are placed in the reinforcements but not enough to explain every detail. However, it is important to know as much as possible why the lateral and the basis have some lengths. It was decided to assembly everything over the basis (two M4 screws) because the screws suffer less with gravity if they are placed in the vertical direction (from the basis to the lateral part). In the horizontal way, the screws from the lateral to the basis are more stressed by the basis weight.

### **Lateral part**

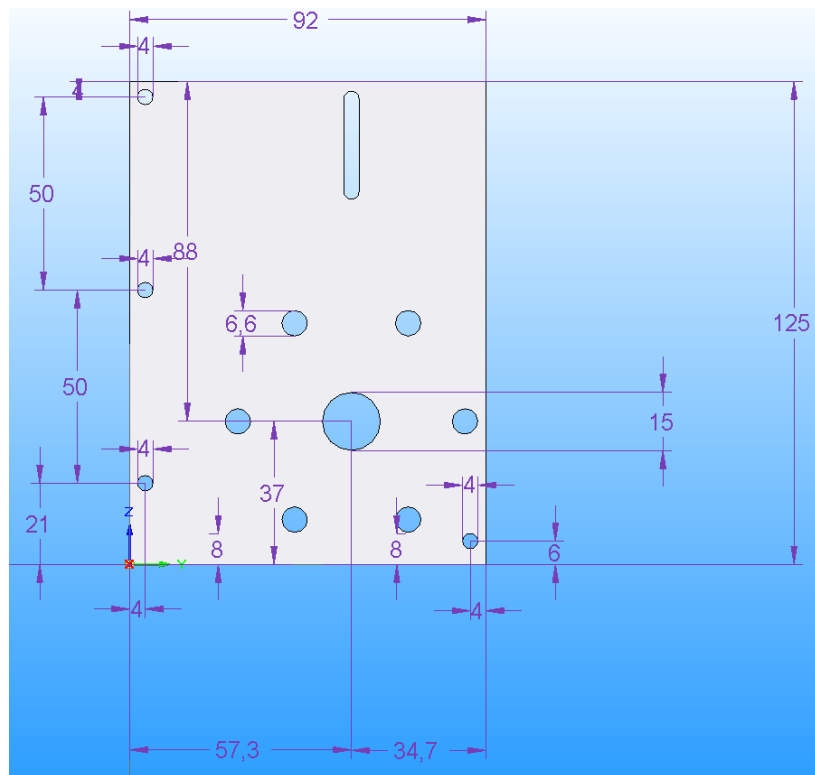
As it could be seen in the figure 2.1.B), the end of the lateral piece we should design is limited with the edge of the flange in the right side. In any other case the lateral piece would collide. It is an important restriction in the geometry of the new holder because it can not be designed symmetrically. So the distance between the center of the flange and the edge (34,7 mm) is chosen as a reference. Moreover, reinforcement in the right side should be pretty short to avoid a collision with the screws from the flange (12 mm high, 8 mm width, screwed on the basis with three M4).

The hight of this piece is also limited by the CCD camera because it has to have at least 80 mm from the center of the capillary to the top edge of the lateral flange. The easier solution is placing the camera with some more space, using a kind of corridor instead of only two fixed holes.

The width is chosen depending on the translation stage, considering that the emitter-holder has a width of 15 mm and all the other measurements in the flange.

The reinforcement in the left side has no restrictions with the lateral, it will be analyzed later.

More specific data can be observed in the next picture (Fig. 2.3):

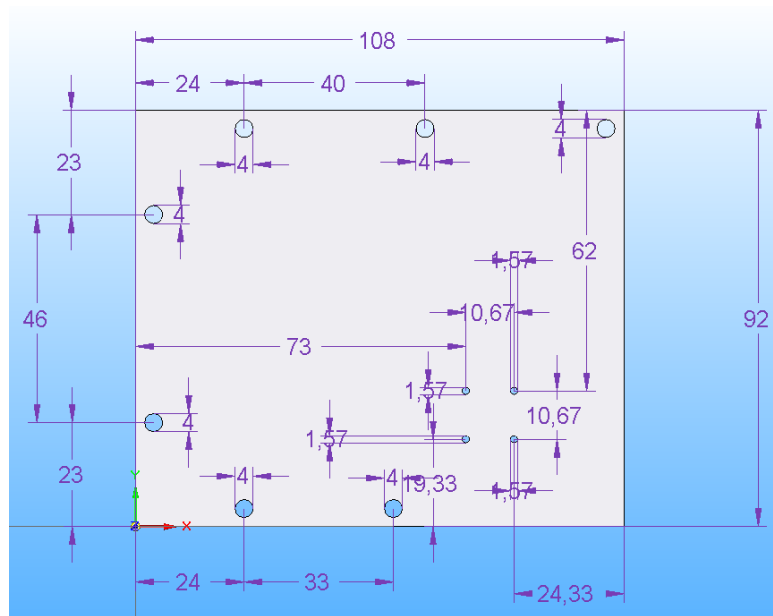


**Figure 2.3:** Measurements and relations in the lateral part.

## Basis

The main point related with the basis is the position of the translation stage (TS). It is important to take care of the ESI-needle measurement (38 mm), from the center of the TS. So we need around 79 mm from that point to the edge of the basis. Moreover, the TS is screwed on the basis with four M2. The width is only restricted by the sizes in the TS, so it is not interesting to talk about that. Anyway, this position influence the reinforcement in the left size, which will have 53 mm (in order to avoid collisions with the TS).

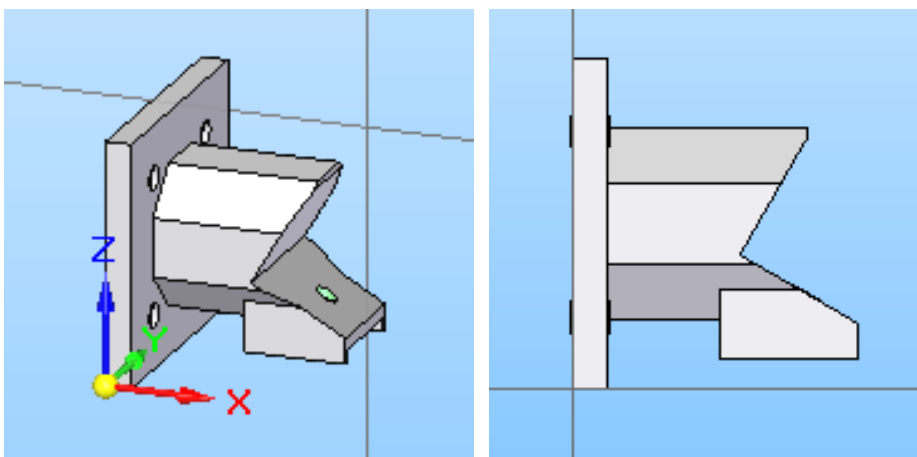
The figure 2.4 explains in a more detailed way all the distances considered:



**Figure 2.4:** Measurements and relations in the basis.

### **Needle holder**

This small part is replacing a similar one. The main difference is the fitting with the translation screw. Anyway, the angles were changed (look at the measurements in the next section –drawings–) to ensure a better stability of the emitter.



**Figure 2.5:** Needle holder.



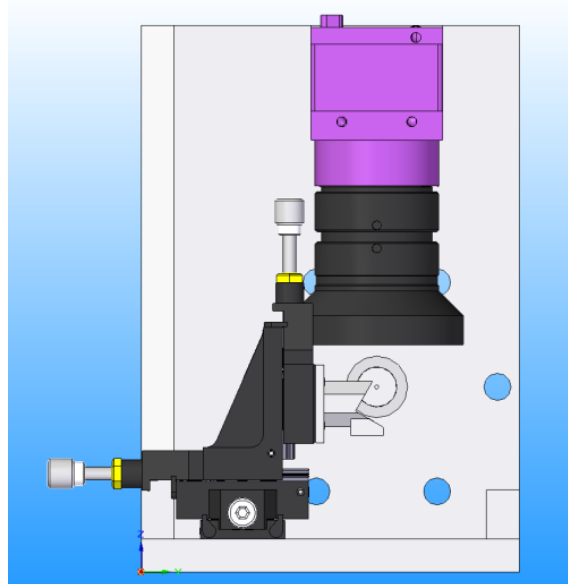
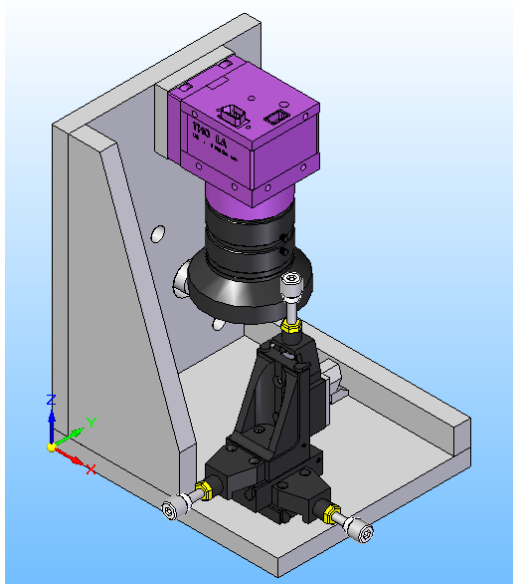
### **3. Solid Edge ST3 design.**

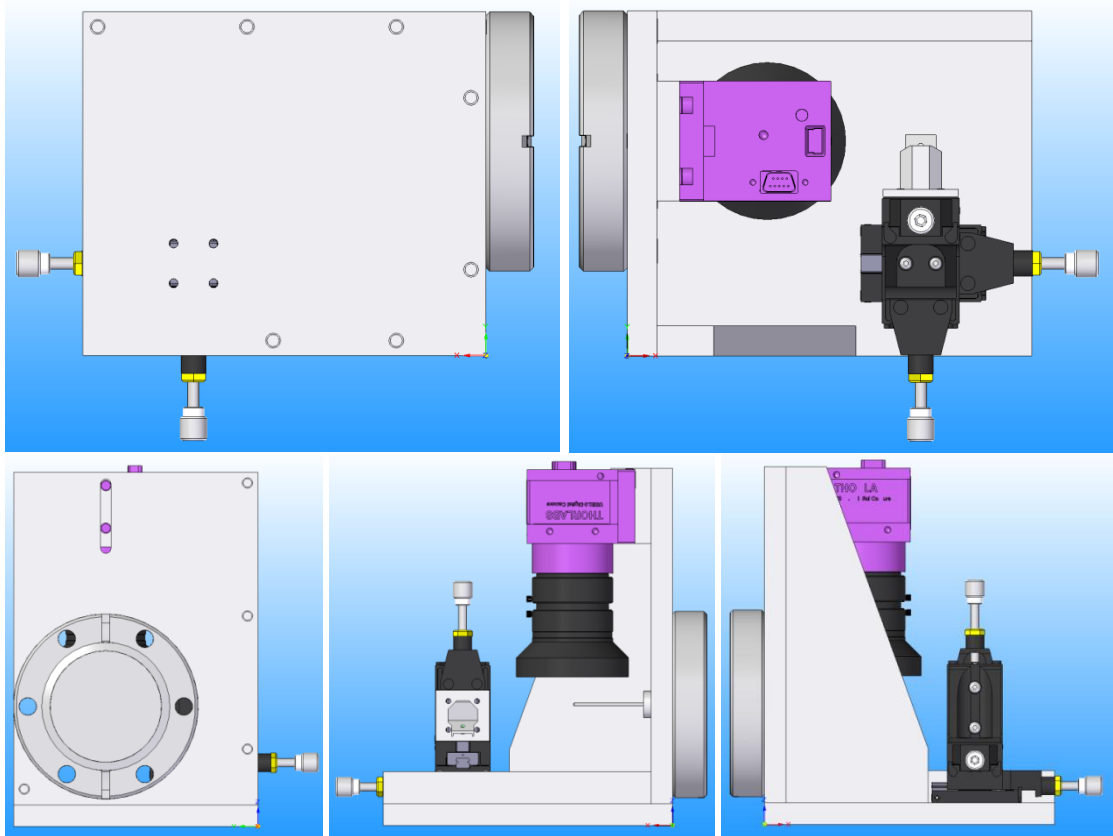
#### ***3.1. Virtual design of the different parts and construction of the assembly.***

The technical explanations about the optimum way to use Solid Edge are not an interesting topic for this report, so they will be avoided as much as possible. Some days or even weeks are needed to be familiar with this software.

In general, the first process was the creation of the different individual pieces in separate '.par' files following the instructions explained in the previous section (2. Requirements and measurements) before fitting them all together in the assembly ('.asm' file).

Looking at the next pictures (figure 3.1) is a excellent way to have an idea about how the construction looks like in different views or perspectives.

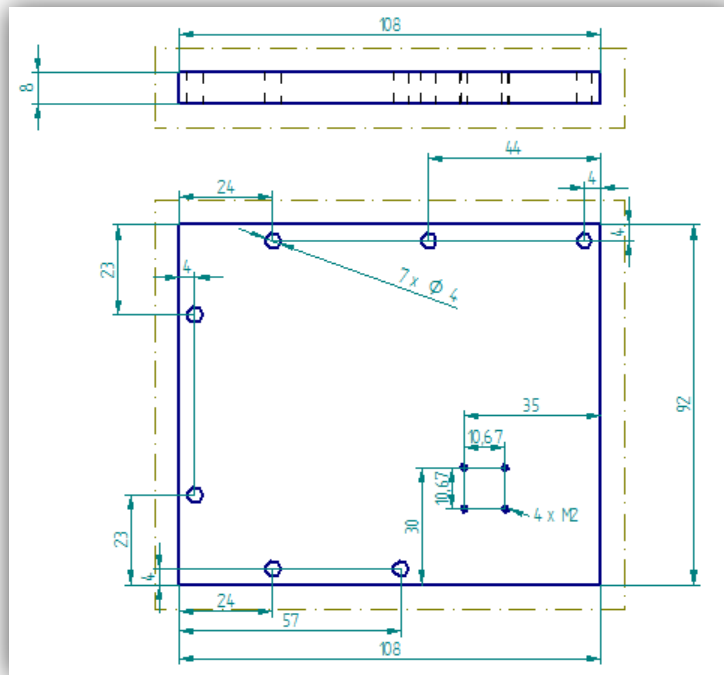




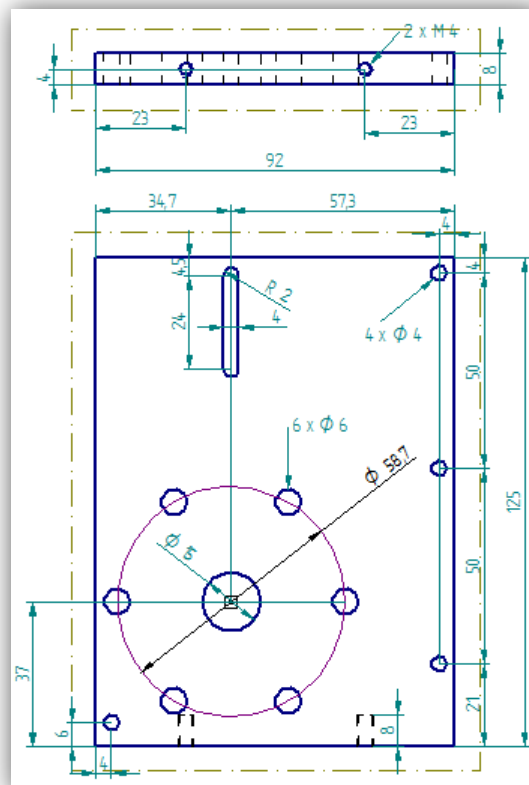
**Figure 3.1:** Views of the Solid Edge assembly. The details of the future construction can be seen.

### **3.2. Drawings for the workshop.**

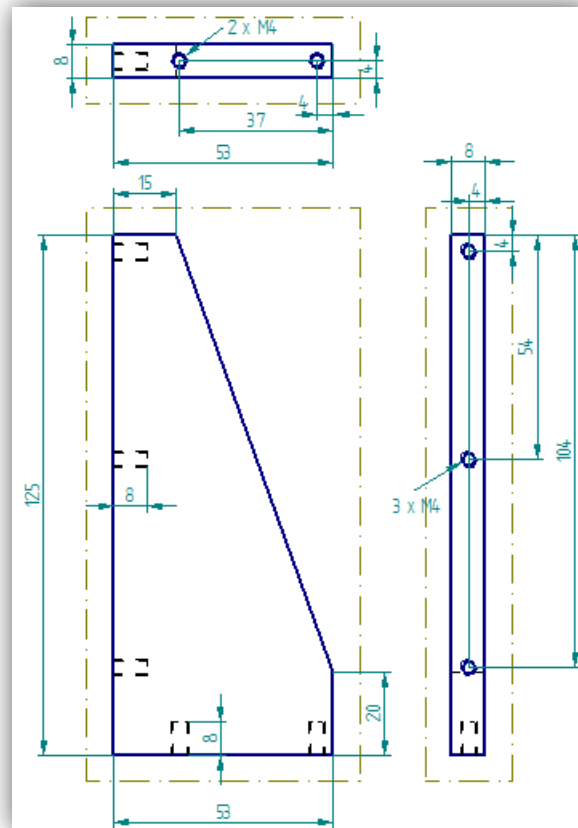
Once all the parts and the assembly are ready, it is necessary to create the drawings for the workshop, what is possible with the drafts files (‘.dft’). This is shown in the next figures (fig. 3.2, 3.3, 3.4, 3.5, 3.6 and 3.7):



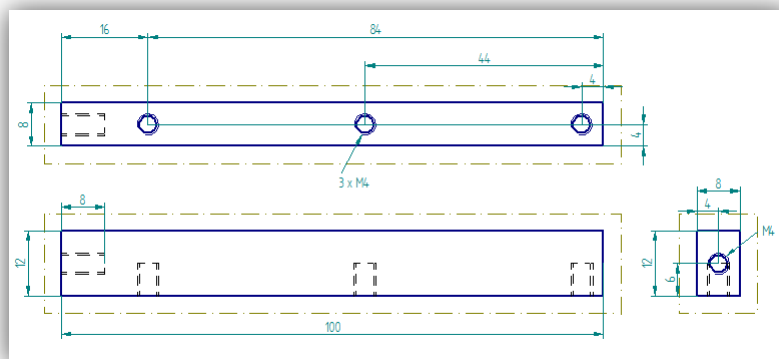
**Figure 3.2:** Drawing of the basis part.



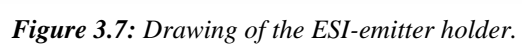
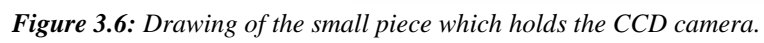
**Figure 3.3:** Drawing of the lateral piece fixed into the flange.



**Figure 3.4:** Drawing of the left side reinforcement.



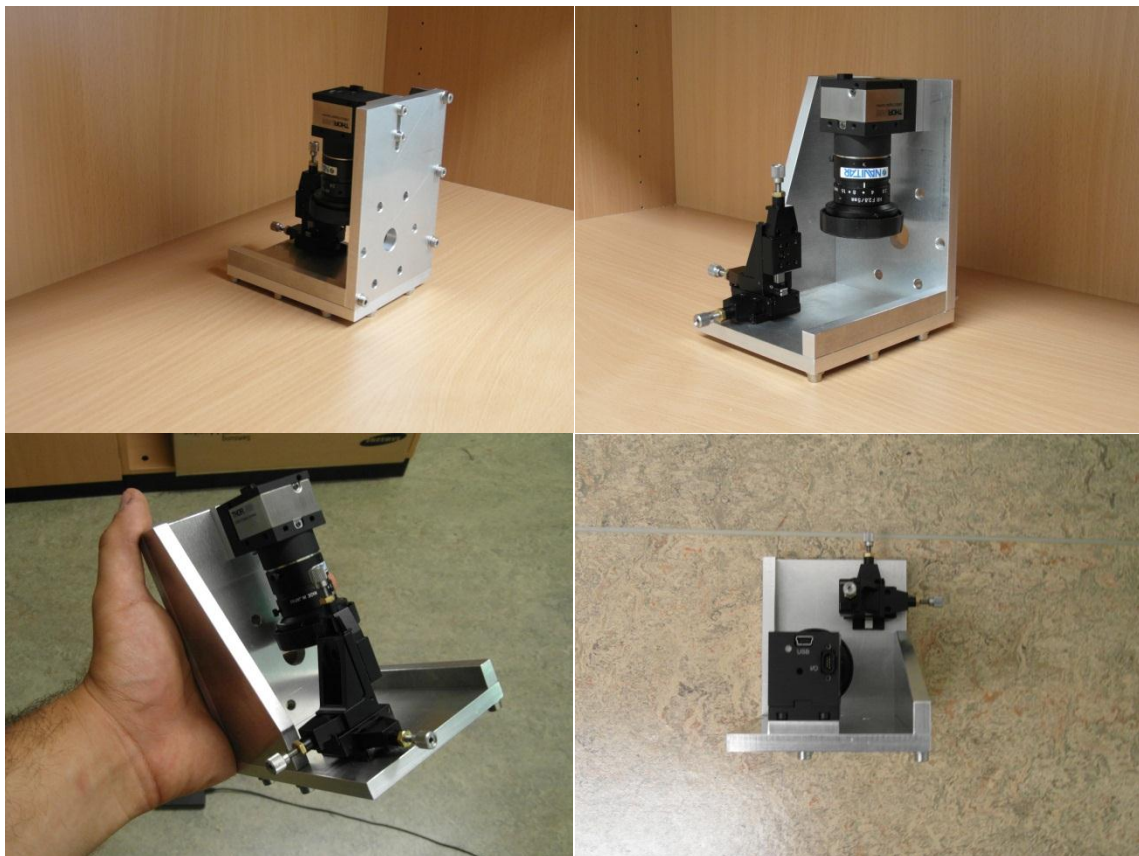
**Figure 3.5:** Drawing of the right side small reinforcement.



#### **4. Summary and outlook.**

Once the drafts of all the pieces were performed separately, they were sent to the workshop to be constructed in aluminium. This process lasted around a week except for the small emitter-holder, which was sent with some days delay and it is still in order to be prepared and it will be ready in some days.

In the next pictures (Fig. 5.1), some perspectives of the real assembly can be observed:



*Figure 5.1: Different perspectives of the assembly.*

Apparently everything seems to be accorded to the requirements and the stability of the device has been already proved so the first aim of the project has been completed successfully.

Finally the real prototype and the computer design can be compared, as can be seen in the figure 5.2:



**Figure 5.2:** Comparison between the Solid Edge ST3 design and the real construction.

In the future it is planned to fit this the device into the flange and take experimental measurements of the ESI source to show that it works properly.

## **6. References.**

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