AN ANALYSIS OF THE MANUFACTURING POSSIBILITY OF SPECIAL ANKLE FOOT ORTHOSIS COMPONENTS BY COMPARISON BETWEEN THE REQUIRED PRECISION AND THE AVAILABLE PRECISION ON A VERTICAL MACHINING CENTER PROGRAMED WITH TOPSOLID

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Abstract*: Validation of different solutions adopted to achieve new ankle foot orthosis involves among others their prototyping. In these paper we developed a representative part for two axis machining that requires the use of the main features of TopSolid Cad and Cam modules, and that assumes the use of the main manufacturing processes that usually may be met on a vertical machining center. Also, in order to determine the dimensional and geometrical deviations of the part this was done on the YMC 1050 machining center. After comparing the measured deviations with the requirements of various components of orthesis, we concluded that the available precision meets the requirements and that the machining center with TopSolid software that we have will enable us to realize special ankle foot orthosis of quality, for experimental research .*

Keywords: experimental orthosis, ankle-foot, manufacturing, TopSolid

1. Introduction

In many research projects to validate the assumptions or the results obtained through simulations are needed real models or prototypes. Also, it is well known that in interdisciplinary research projects, the research team includes specialists in various fields.

This category of research includes many projects and theses developped at the University of Craiova. Involved in such projects, the Faculty of Mechanics trying, using its own facilities or through collaborations with partners, to producethe needed real models for various studies. A such project led by the Faculty of Physical Education and Sports, in which we working as partners, aims to achieve a new and performant ankle foot orthosis.

The ankle foot orthoses are the most commonly used orthoses, making up about 26% of all orthoses provided in the United States [2]. Ankle foot orthoses are externally applied, and are intended to control position and motion of the ankle, compensate for weakness, or correct deformities. They control the ankle directly, and can be designed to control the knee joint indirectly as well [1].

Previous analysis, made by the group of professors and young researchers participating in the above mentioned project, led to the establishment of processing accuracy necessary to achieve of specific components of ankle foot orthosis. Also, given the complexity of forms to be completed, small tolerances and small size of some pieces, we have decided to create a representative part for the manufacturing on a vertical machining center programed with TopSolid Cad&Cam software.

For this decision has been taken into account that our faculty has a YMC 1050 machining center and the mentioned software.

2. The chosen model part to be manufactured on YMC machining center

The chosen part in this paper requires the use of the main features of Design module like points, circles, sketch lines, curves, offset contours, axis and coordinate system in the sketch mode and extrude, boss, drilling, pocket, propagate operation in shapes mode.

Also the shape of chosen part assumes the use of the main manufacturing processes that usually may be met on a three-axis machining center.

The part of which 3 D model has to be completed is shown in the figure 1. That design was realized in the Draft module of Top Solid, after the 3D solid creation.

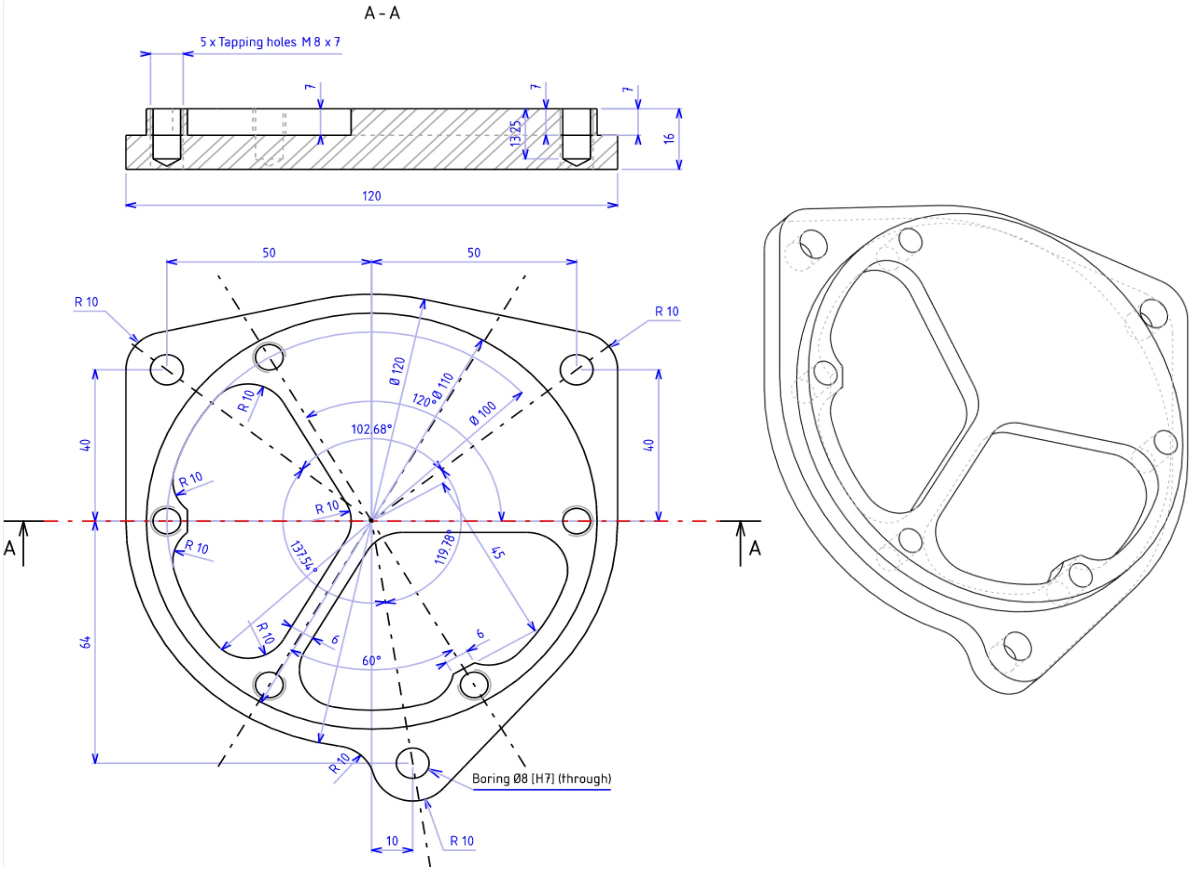


Fig.1 The draft of the part

The part was crated in the Design module of TopSolid Software. The model as developed is presented into the figure 2

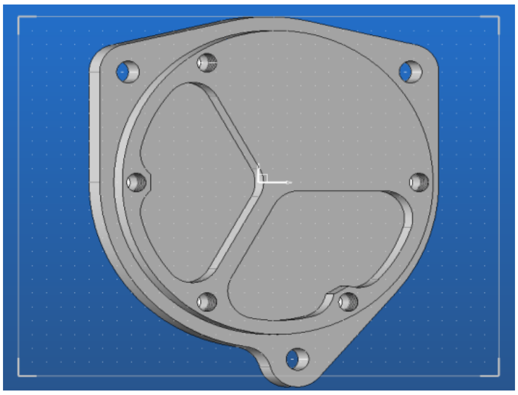


Fig.2 The part model

3. Creating numerical control program in TopSolid'Cam module

The overall programming approach is as follows: selection of the machine tool, definition of the stock model, positioning and definition of the part and of its program origin, definition of the operations with integrated stock model management, simulation, issue of ISO file. Some of this programming steps are presented into the following figures.

The first 2 steps can be skipped by using a document model which already contains the machine and requesting for the stock model to be already defined .

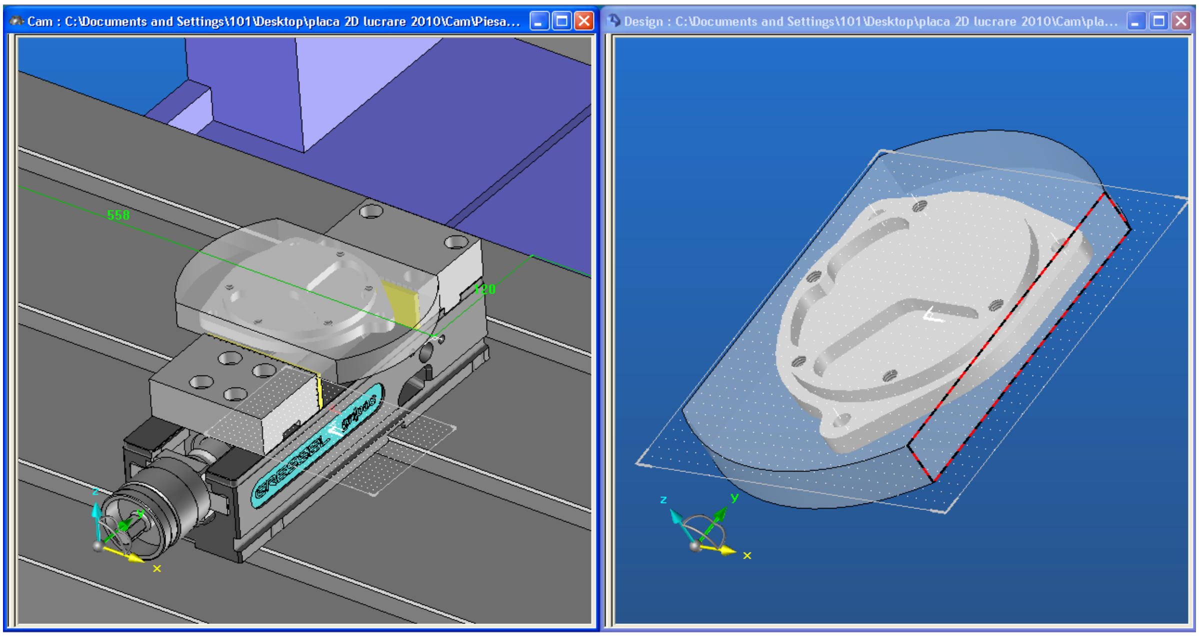
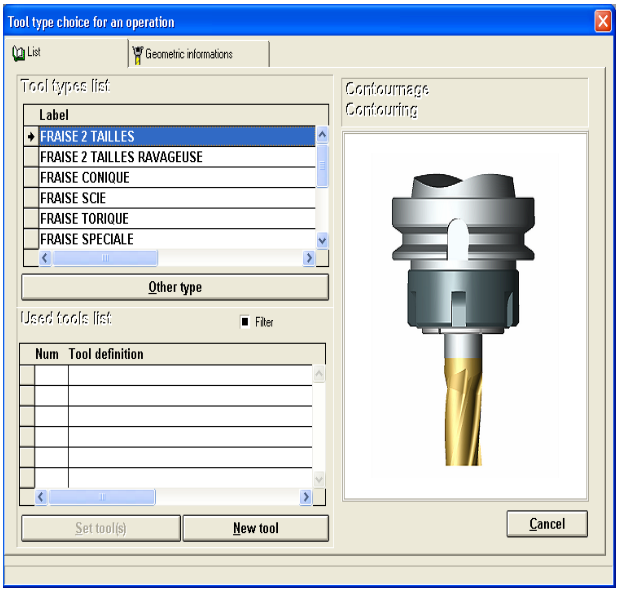


Fig. 3 –Stock mounted on vise(left) and the right side of the stock selection to be put on the vise jaw (right)



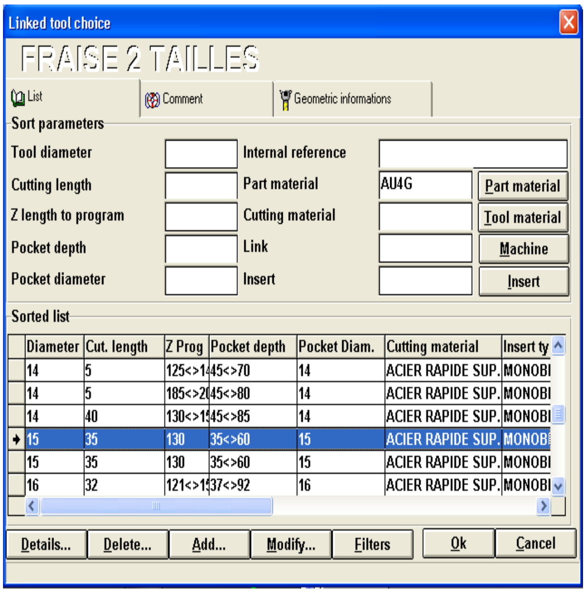


Fig. 4 – Tool type choice

Fig. 5 – Linked tool choice

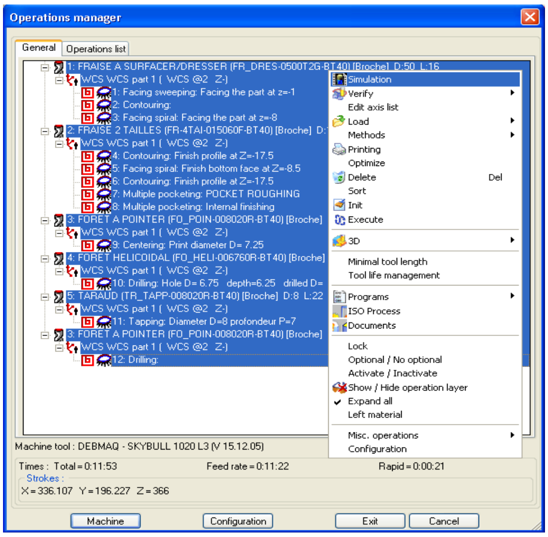


Fig. 6 – Simulation selection

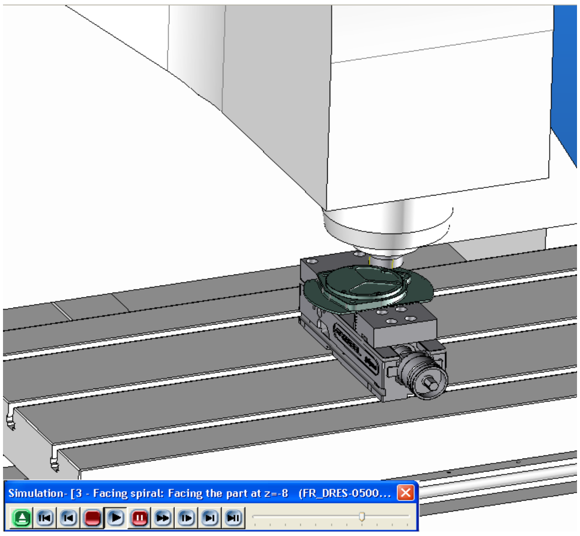


Fig. 7 – Simulation into machine mode

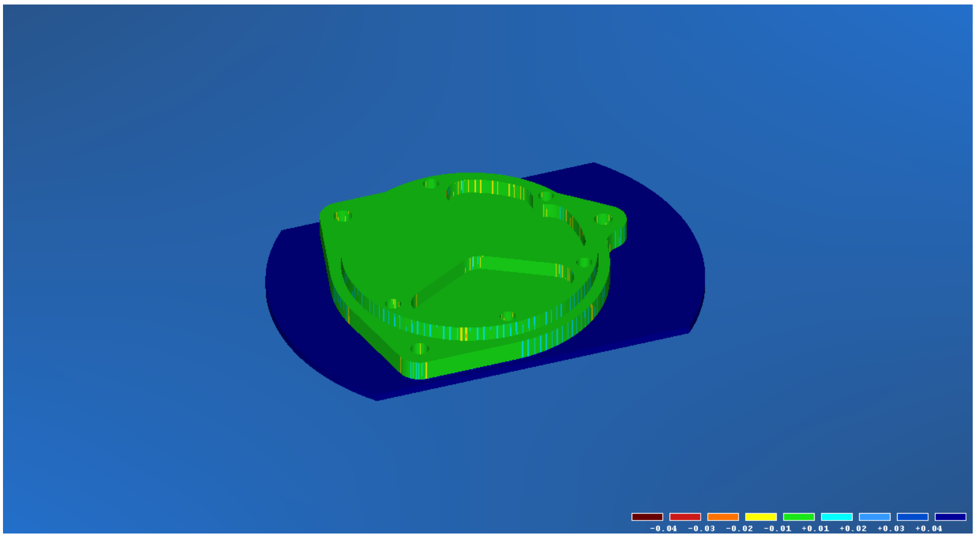
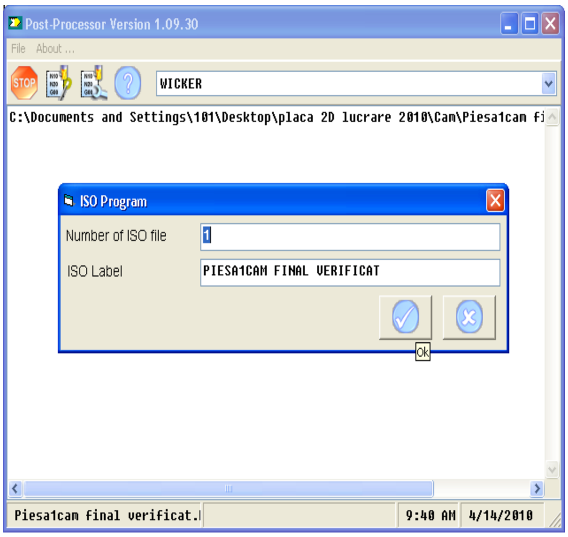


Fig. 8 – Checking tolerances



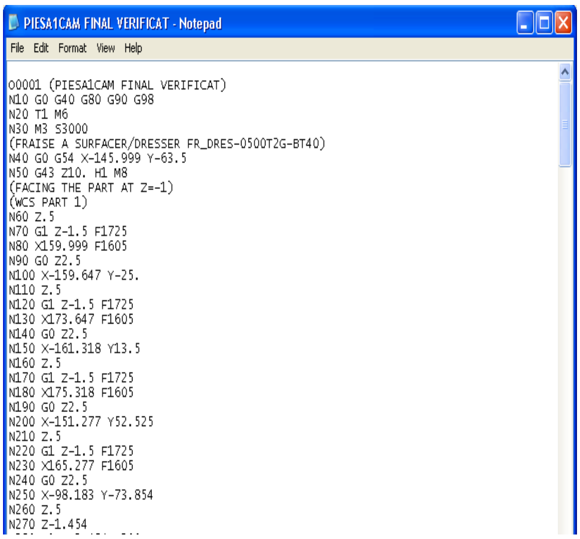


Fig. 9 – Create ISO Program

Fig. 10 – ISO Program file

4. Part inspection and discutions

After the manufacturing of the part on YMC 1050 machining center, this was inspected with a Faro Gage measuring arm. The results of measurements are presented into figure 11.

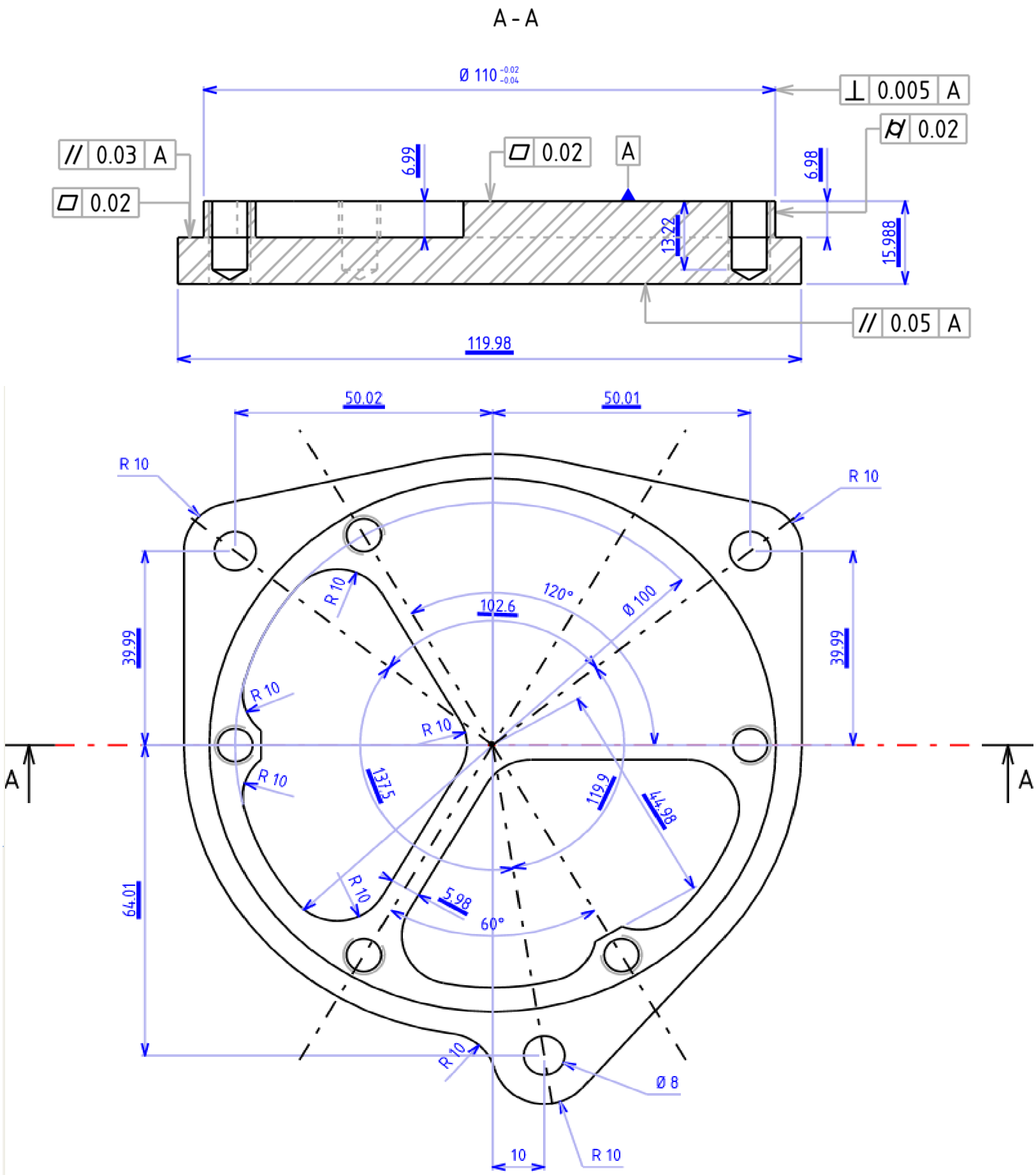


Fig. 11 Measured part – dimensional and geometrical deviations

As we can see, the liniar dimensions deviations not exceed 0,02mm, excepting the Φ110 dimension, which has a maximum deviation of 0,04 mm, that can be caused by the worn of the tool. The maximum angular deviation is 0,12°, and the and geometrical deviations (flatness, cylindricity, perpendicularity and paralelism), not exceeding 0,05mm. The surfaces roughness Ra parameter, measured with a Mitutoyo SJ 201 aparatus, were, after finishing, between 0,1 and 0,5 µm. The part material was a 6060 aluminium alloy.

5. Conclusions

Based on the obtained results after the machining of the part and its inspection, we can conclude:

- the chosen part was used the main cutting operations that can be found on the YMC 1050 machining center;
- the accuracy and surface roughness processed meet functional requirements of advanced orthosis;
- when contouring the surfaces, the dimensional deviations can be caused by the tool wear;
- programming with TopSolid it's a easy way for creating numerical programs of parts with a very complex shapes.

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References

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