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ISO Tolerance specification in reverse engineering

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Abstract

Since the publication of the ISO 14253-1 in 2013 [1]. we have worked in the development of a reliable measurement procedure in reverse engineering. In the beginning, it may seem to be easy to measure a part and to get the estimated value of the sizes and its uncertainties, but several times the dimensional tolerance is not considered, and geometrical tolerances are passed over (unattended).

We propose here a tested procedure, simple and practical for the Industry, in accordance with the requirements of the ISO 14253-1:2013 for fully define the sizes and tolerances of any workpiece in reverse engineering.

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Keywords: reverse engineering; tolerance assignment; functional characteristic.

1. Introduction

The control of a part normally consists on checking its sizes, calculating the uncertainty of the measurement procedure and comparing them with the tolerance interval specified in the technical drawing as it is described in [4]. This is what it is established in the ISO 14253-1:2013 [1].

Moreover, the common practice usually recommends to use a measurement procedure with an uncertainty below the interval of tolerance. Typically, it is used

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$$U < 10\% IT \quad (1)$$

In this ratio, U stands for the expanded uncertainty of the measurement procedure and IT for the interval of size tolerance of the part (International Tolerance §3.2.8.2 ISO 286 1:2010 [2])

But there is another situation quite usual in Industry that it is not straightforward discussed in the Standardization. If the workpiece under measurement has not any technical drawing, as it is the case of Reverse Engineering, the sizes and tolerances are unknown and the scope of the measurement is to specify them instead of verifying the part. In this paper, it is presented the experience carried on different workpieces in order to develop a suitable strategy for dealing with this problem. At the final process of the Reverse Engineering process, the complete Technical drawing of the part will be available, without complex calculations as done in [5].

2. Measurement procedure

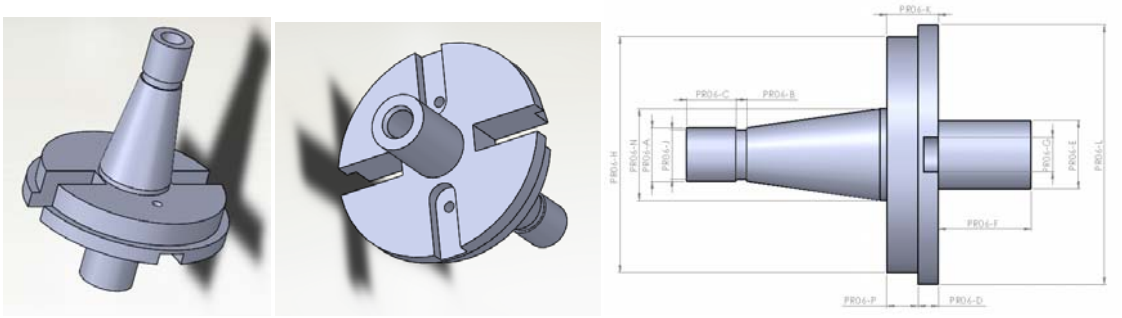
The scope of this proposal was to study the possibilities of the whole procedure, not just focusing in the selection of the measurement instrument. Therefore workpieces of low quality were used, and the instruments selected were calipers. Good enough for the demanded uncertainty and with an adequate measurement range of 140 mm for the considered sizes.

The calipers had a resolution of 20 µm and an expanded uncertainty of 30 µm.

2.1. Measured workpieces

Three different parts were considered, among the ones that were available in the lab. The scope of the process was to assign the IT tolerance in Reverse Engineering, therefore, it is not of interest the final function of the parts.

In Fig. 1 to 3, there are shown the parts and the selected sizes to measure, where PR06 stands for Part with the lab codification 06, PR08 stands for Part with the lab codification 08 and PR05 stands for Part with the lab codification 05.



a) b) c)

Fig. 1. PR 06 part (max. length 160 mm) and measured sizes.