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Digitization Methods of Grinding Pins for Technological Process Planning

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Abstract

The paper presents different techniques for digitizing grinding pins and discusses the use of digitalized pins and the results of measurements in technological process planning (TPP), focusing on the challenges of the digital era. It describes the potential of different measuring devices, taking into account the digitization of a real tool shape into virtual 2D and 3D models. The following methods for measuring grinding pins are presented in the study: contact and non-contact coordinate measurements – performed on coordinate measuring machines (CMM); optical measurements on microscopes (i.e. focus-variation technique); optical measurements using tool presetters; optical measurements with measuring arm; laser micrometer measurements; and laser triangulation sensor measurements. Moreover, the use of testers which are applied in contour measurements is analyzed. On the basis of the presented methods, taking into account their possibilities and limitations, we discuss how the obtained digital data can be used in the planning of technological processes.

Keywords: grinding; machining; digitalization; digitization; technological process planning

1. Introduction

Grinding pins are grinding tools with small diameters compared to their length, which are applied in different abrasive machining tasks, such as the grinding of holes and external surfaces, rounding of edges, pocketing, grooving, engraving and also in drilling. They are rotating tools which are clamped to the spindles of machine tools by the use of different types of tool holder. Today, computer numerical control (CNC) machine tools are widely exploited by industry, including various types of high cutting velocity (v_c) spindles, suitable for the rotation of small diameter tools, such as grinding pins [1,2]. Grinding pins consist of a metal mandrel and a fixed abrasive layer, with or without a through-hole. The mandrel is intended for clamping the tool, and its shape should be coincident with the tool holder used. The shape of the abrasive layer is usually adapted to the required part feature (i.e. cone, cylinder, disk, etc.). There are two main types of grinding pins – conventional and super-hard. Conventional abrasives (e.g. corundum or silicon carbide) are used in conventional grinding pins, commonly applied for the grinding of steels, cast iron or some brittle materials. Super-hard grinding pins consist of diamond or cubic boron nitride (CBN) grains bonded by different types of binders, such as metal, galvanic, resin, vitrified, and hybrid [3]. Diamond pins are used in the machining of brittle materials (e.g. carbides, ceramics, glass), whereas CBN pins are suitable for grinding of steels. This is mainly due to the well-known diamond chemical affinity for iron which makes it possible for tool producers to manufacture and offer both diamond and CBN pins [4].

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