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Dissertation title

Analysis of finish turning of turbine disk seals made of sintered nickel-cobalt-based superalloy for the *New Generation Product Family* (NGPF) of aircraft engines using a cBN insert with modified cutting edge geometry.

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Abstract

The paper was inspired by the practical challenges faced at the Pratt & Whitney Rzeszow S.A. (PWR) company during the implementation of machining processes of components for the modern aircraft engine turbine designs. Dissertation is dedicated to issues related to finish machining of a unique nickel-cobalt alloy patented by United Technology Corporation (previous shareholder of Pratt & Whitney) used for rotating seals of PW800 and PW1000 turbine engines families, so-called *New Generation Product Family* (NGPF)

The study investigated the phenomena related to the cutting mechanics process and the properties of the *Technological Surface Layer* (TWW) of the mentioned alloy. In the scope of the research, the influence of the cutting edge geometry on the course and nature of wear of the tool made of *cubic Boron-Nitride* (cBN), the components of the cutting force (main cutting force, trust force and feed force), surface roughness, residual stresses, hardening and morphology of the surface layer were observed. In the study, modern cutting inserts with a cBN tip with a VBGW geometry and a corner radius of 0.8mm were used, as well as four cutting edge preparation profiles, which are described as - two chamfers of 0.06mm x 20° and 0.05mm x 15°, and two radiuses with radii of R0.02mm and R0.01mm. Due to the material and applied finishing parameters, i.e. small cutting depths and feeds and relatively fast tool wear, classical formulas for calculating cutting forces and surface roughness parameters based on tool geometry, process kinematics and workpiece material properties are not applicable due to relatively high errors in relation to the actually measured values. In this paper, based on the planned experiments, mathematical models of the components of the cutting force and selected surface roughness parameters were developed. The conducted observations and analyses of the

results showed that the profile of the cutting edge is an important factor affecting vital aspects from the manufacturing process point of view, such as cutting forces, tool life, quality and occurring defects of the machined surface, which affect the cost and ability of the machining process to provide the expected parameters of the product. The results of the work contributed to a better understanding of the phenomena and the impact of cutting edge geometry on the machining process and surface layer quality, successfully applied in practice, in the machining processes of critical rotating parts made of nickel and cobalt-based superalloy and other parts made from superalloys at PWR.

Keywords: tool wear, cutting forces, surface roughness, superalloys, nickel and cobalt based alloys, finish turning, cBN tools