Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 192 (2017) 563 – 568

Procedia Engineering

www.elsevier.com/locate/procedia

TRANSCOM 2017: International scientific conference on sustainable, modern and safe transport

Verification of new method of determining the roughness parameters for rotational turning with non-linear cutting edge

Pavol Martikáň[a]*, Andrej Czán[a], Jozef Holubják[a], Daniel Varga[a], Juraj Martinček[a], Tatiana Czánová[a]

[a]*Department of Machining and Manufacturing Technology, Faculty of Mechanical Engineering - University of Zilina, Univerzitná 1, 010 26 Žilina, Slovakia*

Abstract

Technology of rotational turning is a progressive chip machining technology with a defined tool geometry, which in some cases can replace conventional finishing technologies with undefined geometry of the cutting tools.
The paper deals with the influence of the cutting parameters of the rotational turning on the surface roughness after machining and comparing the roughness parameters with the theoretical roughness calculation. Since this is a new machining technology with new kinematic structure with atypical geometry of the cutting tool, the paper deals with the measurement methodology of the certain roughness parameters on machined surface after rotary turning with nonlinear cutting edge.
Executed experimental tests and their evaluation are verified with the method of roughness parameters determination and results show, how the real process correlate with implementation of empirical relations.

Peer-review under responsibility of the scientific committee of TRANSCOM 2017: International scientific conference on sustainable, modern and safe transport

Keywords: Rotational Turning ; Hard Machining ; Roughness Parameter ; Non-Linear Cutting Edge

1. Introduction

Turning with rotational feed (rotational turning) is a novel cutting process, which is based on a combination of hard turning and circular milling, see Fig. 1. In rotational turning, the tool is an extract of a large milling tool with a long

* Corresponding author. Tel.: +042944501003.
E-mail address: pavol.martikan@fstroj.uniza.sk

Peer-review under responsibility of the scientific committee of TRANSCOM 2017: International scientific conference on sustainable, modern and safe transport
doi:10.1016/j.proeng.2017.06.097

pitch and large tool diameter. The cutting edge in rotational turning which is made of pCBN is helical, although prima facie it appears to be linear. For machining, the tool rotates from position A to position B thereby the contact point between edge and rotating work piece where material is cut is moved axially along the workpiece rotating axis. The rotation of the tool can be achieved by NC-tool turrets with torque drive, which is state of the art in many turning machines [1,2].

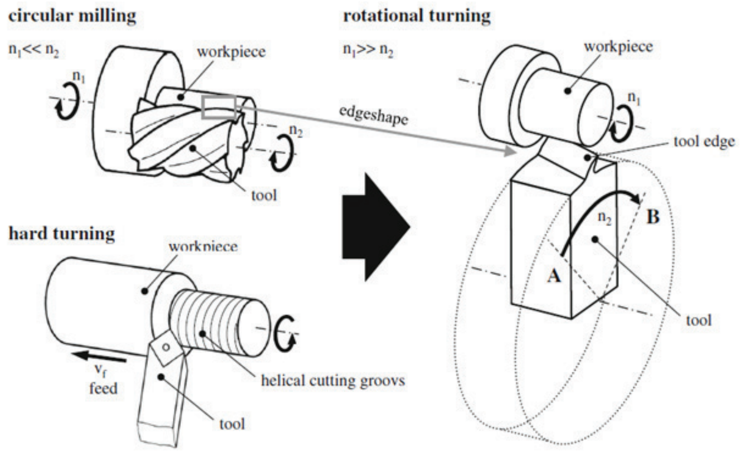

Fig. 1. Functional sketch of rotational turning in comparison to circular milling and hard turning [1]

Turning with rotational feed (rotational turning) of outer cylindrical surfaces can be characterized by a tool which works with a slow, rotational movement – in contrary to the axial feed in traditional longitudinal turning – thus generating the machined surface by the non-linear contact of the cutting edge and the workpiece instead of point contact [3,4]. The cutting edge can be made from a material capable of machining hardened steels, and therefore, rotational turning is also applicable to the finishing operations of hardened surfaces [5].

There are a few publications so far, which contains theoretical and experimental examinations on rotational turning. The work of Klocke et al.[1] presents rotational turning as a novel cutting procedure by the combination of longitudinal turning and peripheral turn-milling. The aim of their study is to determine the achievable surface roughness. They calculate the theoretical value of total height of profile (*Rt*) by the well-known equation with axial feed and the nose radius [6,7]. In this paper is compared real measured values of Rt with anoteher calculation based on mathematical eq. 1.

2. Theoretical calculation of Rt

Rt (total height of profile) can be used to foresaw the quality of machined surface, as its theoretical value can be simply calculated from machining parameters and tool geometry in conventional turning. To achieve theoretical value of Rt in turning with helical cutting edge, it is necessary to define it graphically and then defining its equation using parameters which defines the technology of turning with helical cutting edge as the revolution of tool, that is the main difference in comparison to conventional turning.

$$Rt = r_{tool}.\left(1 - cos\left(\frac{f_a}{2r_{tool}\, tan\, \lambda_s} + \frac{n_t.\pi}{n_w}\right)\right) \tag{1}$$

Equation 1 shows that theoretical value of Rt, by turning with helical cutting edge, depends on tool radius r_{tool}, machine feed r_{tool} and revolutions ratio of tool and workpiece, see Fig. 2. [8]