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LASER CUTTING MACHINE AND OPTIMISATION OF INPUT PARAMETERS FOR FRUITION REQUIRED QUALITY OF PRODUCTS

LASEROVÝ DELIACI STROJ A OPTIMALIZÁCIA VSTUPNÝCH PARAMETROV PRE DOSIAHNUTIE POŽADOVANEJ KVALITY VÝROBKOV

Abstract

The paper depicts the process of cutting sheet metals by the laser machine TRUMATIC L 4030 and indicates the possibilities of machine control based on the roughness measurement. It points out the importance of correct adjustment the input parameters of the laser machine at cutting sheet metals from unalloyed structural steel. The quality of cutting edge depends mainly on its input parameters (the speed of cutting jet, the distance of the jet from the material, power of laser and its pulse frequency or gas pressure). The control system generates suitable parameters by means of technological tables. With respect to various influences (outer, inner, material, technological...) which intervene into the production process, the output quality of the cutting edge cannot be guaranteed. It is possible to raise the quality of production by measurement of the roughness parameters, their estimation, comparison to required values and next intervention - optimisation of input parameters of the machine.

Abstrakt

Článok popisuje proces delenia plechov laserovým strojom TRUMATIC L 4030 a naznačuje možnosti riadenia stroja na základe merania drsnosti. Poukazuje na dôležitosť správneho nastavenia vstupných parametrov laserového deliaceho stroja pri delení plechov z nelegovanej konštrukčnej ocele. Kvalita delenej hrany závisí predovšetkým od jeho vstupných parametrov (rýchlosť pohybu deliacej dýzy, vzdialenosť dýzy od deleného materiálu, výkon lasera a jeho pulzná frekvencia, tlak plynu). Riadiaci systém generuje vhodné parametre prostredníctvom technologických tabuliek. Vzhľadom na rôzne vplyvy (vonkajšie, vnútorné, materiálové, technologické...), ktoré zasahujú do výrobného procesu nedokážeme zaručiť výstupnú kvalitu delenej hrany. Meraním parametrov drsnosti, ich vyhodnocovanie, porovnávanie so žiadanými hodnotami a následným zásahom – optimalizáciou vstupných parametrov stroja je možné zvyšovať kvalitu výroby.

1 INTRODUCTION

Automation meaning in engineering manufacturing icreases with requirement to produce big duplicate parts. Quality requirements of parts are coessential as their quantity. Laser-cutting of sheet metals offers facilites for automatization of operations and parameters settings.

Supplyers offer many cutting machines, they are with assorted level of automation, mostly with many automation function. Leader of that machine type is laser cutting centre Trumatic L4030 with CNC control. When a customer requires prompt production, the machine cut with such quality of cutting edge, that it is sometimes nonconforming for the customer. There is requirement to

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measure roughness of the cutting edge on cut items. This is now done manually and analysed. Sequentially operator manually takes on settings and empirically amends relevant parameters. This way is not optimal for time limits. There is a question, how to control this process, so that machine could as work continually as possible. It is necessary to automation operation of measure roughness, analyse of measured values and sequentially take with control system to cutting process for effective modification of cutting speed.

2 AUTOMATION OF CUTTING PROCESS

Controlled technologic process and automation means form complicated system. In this system control signals are transferred and there is also outer signals action. Properties of this system in term of control are defined by value changes, that determine system status in every point depending upon outer value changes that act upon it [3]. Optimal behaviour criterion of system can be different, besides optimal course of dynamic characteristic there can be optimal power consumption, economy, reliability, quality of producing products, etc. Laser machine control is realized so that control equipment could generate parameters. Then process run with minimum power costs. Practically, system suggests such cutting speed, that parts are produced quickly, but not in the highest quality. Manufactured parts have then extreme roughness, it interprets principle of this technology.

3 EVALUATION OF THE CUTTING EDGE ROUGHNESS

Deciding parameter for resultant roughness is cutting speed (speed of laser jet movement). There is not direct proportion between cutting speed and quality of cutting edge. The roughness may be assessed in term of macrogeometry or microgeometry according to customer's requirement. Most frequently there are requirements of level and smooth surface that is typical for this technology.

On Fig. 1 there is view of cutting edges of experimental samples made by assorted cutting speeds. Input parameters are manually changed and entered into control system of machine through technologic table. Surface quality gets worse with diminishing speed. In case we increase cutting speed very much, quality gets worse. In the extreme situation the base material is not separated from device.

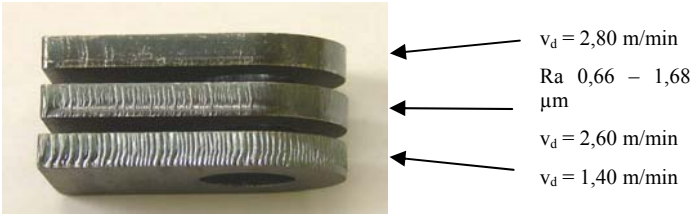

Fig. 1 View of cutting edge of experimental samples made by assorted cutting speeds [4]

On the next graph there is visibled course of the roughness values that were measured on individual samples. Cutting speed change impact on resultant roughness of cutting edge is clear from this graph.

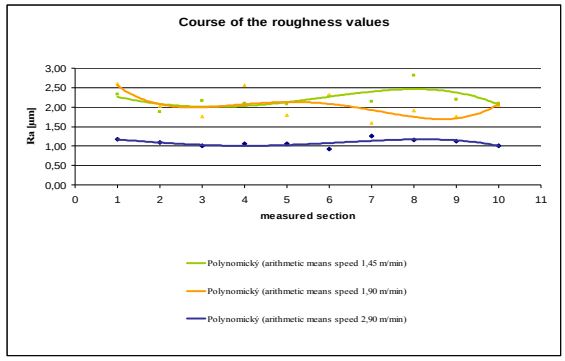

Fig. 2 Course of the roughness values of the cutting edges [4]

4 CO_2 LASER CUTTING CENTRE

Lasers CO_2 are suitable for operations that require high load in continual mode. Their applications have reference not only to metals, but to all other non-metallic elements, that absorb energy with wave length 10 600 nm well. Lasers CO_2 are usually used for welding and cutting metals Fe, Ni, Sn, Pb and alloys.

Fig. 3 Laser cutting centre TRUMATIC L 4030 [5]

5 CONTROL OF LASER CUTTING CENTER

Control of machine is done by display TASC 3, that is directly connected with machine control and integrated to the service centre. It features with option of direct graphic view of process course. It controls power of laser depending on cutting speed. On Fig. 4 there is schematic diagram of numerical control in closed loop that is pc-based with on-line instruction commands generating for the control subsystem of movements and control subsystem of machine function.

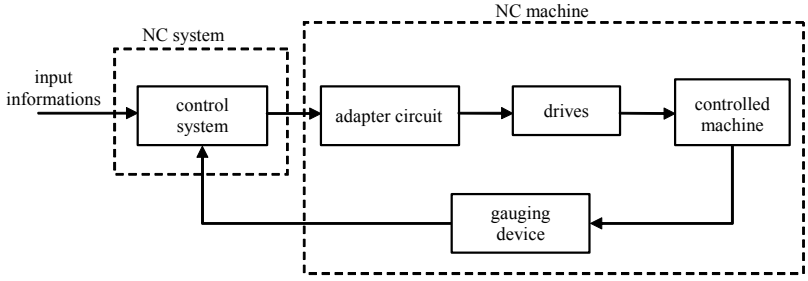

Fig. 4 Schematic diagram of numerical control

5.1 Activities of control section

The machine can work in three modes, activities of which are incompatible. Single modes include activities that do not work in other modes than they are programmed.

The first work mode of control section is mode AUTOMATIC - in it only manufacturing *activity* runs. Activity *removal* runs by mode MDA (Manual Data Automatic) and activities like *programming, service and diagnostic* run only in mode JOG.

Setting stage of operations realization is realizated through technologic tables (Fig. 6). By relevant algorithm adhering the operator obtains output parameters on base of input parameters. (Fig. 5).

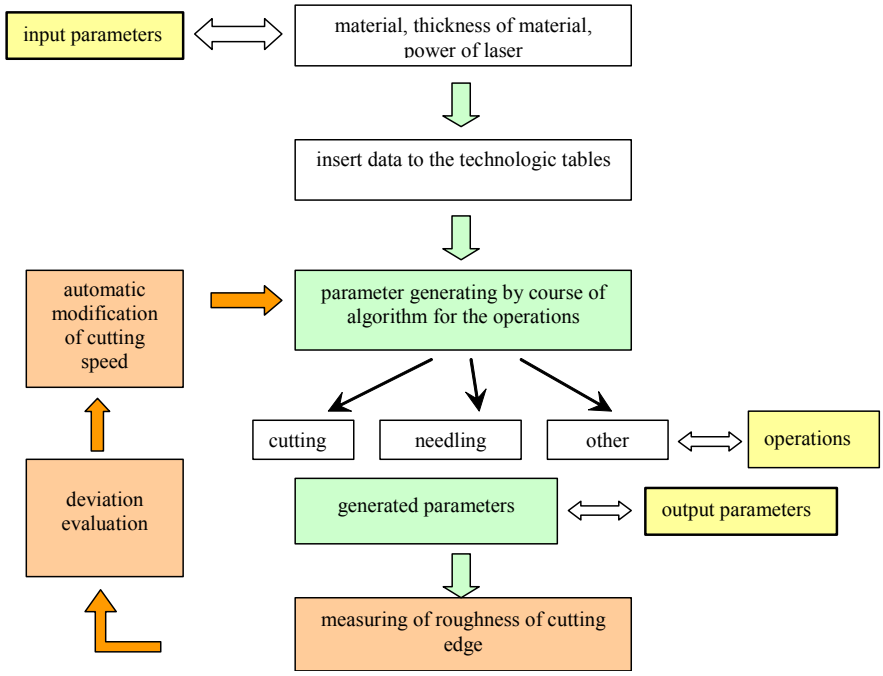

Fig. 5 Algorithm of parameters setting

6 AUTOMATION ELEMENTS OF MACHINE CONTROL

By means of technologic tables prompt adaptation for various materials and thickness sheets can be realized. All parameters are preset for often used materials and they are activated automaticaly by table. On the Fig. 6 there is an example for system environment of parameter setting for cutting. It can be seen, that cutting parameters are different for construction size (large, small, medium). These parameters are:

- joint width
- currently power of laser and pulse frequency
- cutting speed
- the distance of the jet from the material
- gas pressure
- gas pressure

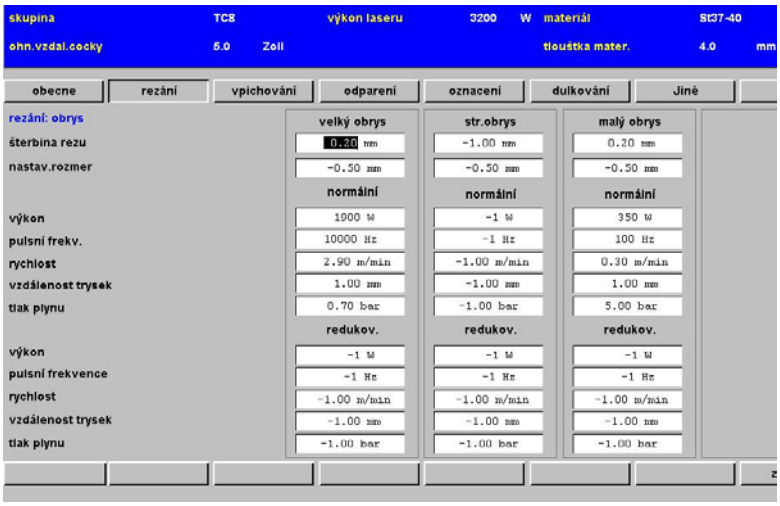

Fig. 6 Environment of parameter setting for cutting

7 AUTOMATION OF ROUGHNESS MEASURING OF PRODUCT

For elimination of manual intervention on machine adjusting it would be necessary to put final inspection on roughness measuring by means of suitable sensors. They monitor value of measuring roughness and confront it with specifications from configuration utility. Consequently there would be automatic regulation of speed of cutting jet by course of specific deviation. In this manner feedback created is. Technologic tables offer parameter values that influence roughness. Technologist chooses of them according to quality specifications.

Such change in control system claims attention for several points. It is important to solve these aspects of concept:

1. design of acceptable sensoric system, automation measurement method of roughness value scanning - through contactless transducer [6].
2. evaluation method of measured values
3. modification of algorithm for automatic modification of parameters - by inserting comparison element (Fig. 5).

8 CONCLUDING REMARKS

Roughness of cutting edge belongs among main indicators of quality on thermal laser cutting. It is important to raise the automation level of workstation continually, as production when most optimized. Various elements help technologist to make easier and faster decisive process in a phase of machine setting. One of the possibilities is the offered solution of roughness monitoring and consequent modification of specific parameter at cutting process.

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