

# Research in the process of burr measurement of metal parts

Ferenc Boronyák<sup>1</sup>, Dr. András Hány<sup>2</sup>

<sup>1</sup> Technology Center, Zalaegerszeg, 4. Fészek street, Zalaegerszeg; ferenc.boronyak@tc.org.hu

<sup>2</sup> APNB Kft., 4. Fészek street, Zalaegerszeg; andras.hary@apnb.hu

**Abstract** – The research in measuring burr on metal parts aims to find such a solution to measure small (<0,1 mm) burrs on the production line with which the part can reliably be qualified. During the research, we especially concentrated on the cap at the end of the neon tube. In order to resolve the problem, we analysed the phenomenon of the formation of the burr, along with cutting and punching technologies. After having reviewed the burr measurement processes, we performed tests with different measuring solutions and ideas in order to measure the burr. During the experiment, it turned out that more processes are applicable with various accessories. Among the solutions, one is outstandingly better than the other, as it is not only simple but does not require the destruction of the product.

## I. INTRODUCTION

The topic of the research is to work out the process of burr measurement of metal parts which were processed by sheet presswork. The part is the metal 'cap' at the end of the neon tube (Fig. 1). The part goes through different steps; punching, bending, deep-drawing processes, until it gets its final shape.

The following subtasks were defined:

- researching the phenomenon of burr formation, analyzing cutting/punching technologies
- overviewing burr measurement process
- choosing the appropriate burr measurement process
- validating the advised process, experiments in series production
- summarising results, preparing the new technological process description.



Fig. 1. The inspected part

## II. PROBLEM ANALYSIS

Sheet metal processing activities produce the final part to be examined by a so-called fine-cutting process. This technology results in a bigger size precision and better surface quality compared to traditional cutting. The formation of the tool and the way of designing are more complicated, but using this tool is essential to reach the needed quality in some cases. [1]

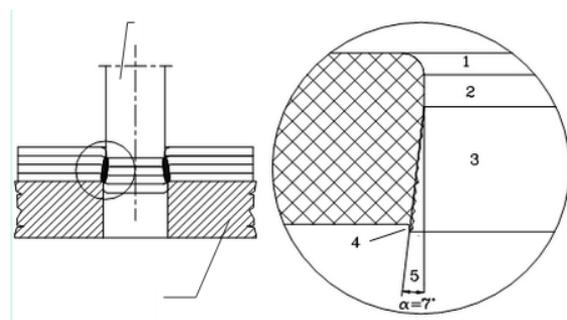


Fig. 2. The inspected part [2]

In case of cutting, one-third of the cut surface is formed by plastic deformation (bright surface), two-third is formed by fracture. The cut surface is not perpendicular to the plane of the sheet. The deviation from the plane and the amount of the forming burr are huge (Fig. 2.). The geometry of the cut surface depends on a lot of factors:

- the thickness of the cut sheet,
- the size of the cutting gap,
- the mechanical features of the sheet (solidity, breaking load, stretching, isotropy),
- the condition and wearing of the cutting tool,
- lubrication of the tool. [3]

The effect of the cutting gap to the cut surface geometry in case of mild steel (max: 75 HRD) is shown in Table 1. after being cut and punched.

Table 1. – Amount of cutting deficiencies

Cut surface characteristics	Cutting slit	
	(0,17-0,21)-s	(0,115-0,125)-s
Deviation from merit [°] (A)	14 -16	8 -11
Edge retraction [mm] (R)	(0,1-0,2)-s	(0,15-0,25)-s
Broken surface [mm] (F)	(0,7-0,8)-s	(0,6-0,75)-s
Burr height	nagy	normál

The main cause of forming burr is the inappropriate size of cutting gap, which on one hand can generate from design errors, and on the other hand, from the deficiency of the tool's inappropriate size due to production errors or wearing.

The big pressure at the edge can result in the wearing off of the edge, and the presence of the tensile state can cause breakage. Due to the big surface pressure the rubbing effect can cause abrasion. [4]

More abrasive and repetitive damage can arise from the vibration of the machine's pressing ram. During usage, the edge become worn-out, this increases the force demand of the cutting and the height of the burr on the part. [2]

### III. EXPERIMENTS

We have examined more among the burr measuring possibilities:

- Roughness gauge

It is usable for the experiments because its feeling strength is low (4N). Its disadvantage is that the

measurement is not convenient; the size of the tester head is limited.

- Measuring gauge

It is usable for the experiments because its feeling strength is low (4N). It is easy to use. Its disadvantage is that it can be used after the destruction of the piece.

- Laser profilometer

This procedure requires complicated machining and setting. The necessary measurement result cannot be guaranteed in the shop floor as the tester head is sensitive to the positioning of the part.

Another disadvantage is its definitely higher price compared to the tools we have examined so far. Besides, its measuring accuracy depends on the quality of the surface, as in case of bright surfaces the interference is big, and the observed profile can be different from reality. [5]

- Digital microscope

The bended part is visible on the profile which was formed during processing. The tool would be capable of measuring the burr, but cannot be used in the shop floor as it is sensitive.

Its measurement accuracy is far beyond the expectations, however its price is multiple compared to that of the laser tool, so despite the positive features, it cannot be counted as an acceptable measurement process in this issue.

- Comparative examinations:

The basis of the comparative examinations is the comparison of the unknown part to an object that we know the size of. We compare their sizes if its size is bigger or smaller than the examined sample.

These methods do not give numerical data - or indirectly only, nevertheless, they can be used to qualify parts in a way that if the size of the known object is the same as the biggest allowed size of the sample - in this case, of the burr, then it can be stated that the part is within or out of tolerance range.

a) With a microscope

We made an examination with a simple microscope, during which we positioned the burred foot on the slide and placed a 0,1 mm big shim there. We reduced the image in a modelling software to the proportionally needed size, and we measured the height of the burr with help of the applied sketches. (Fig. 3.)

Due to the simplicity of the measuring process, this can be used in the shop floor, too, its price is low, so it can meet the requirements. The disadvantage of this method is that it needs a relatively accurate positioning, but with a special jig this problem is solvable. Destructing the samples is unavoidable to make a clear view, but in case of such a high volume production this small quantity does not influence the production output significantly.

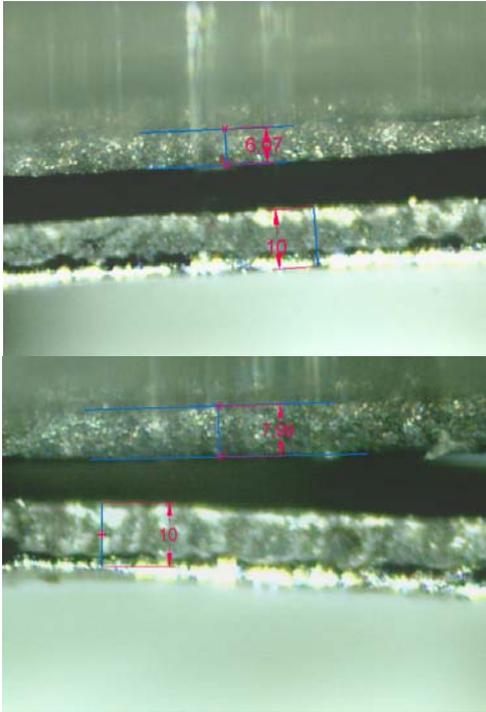


Fig. 3. Measurement

b) Polymer surface replica

Several scientific publications have been available about using polymer surface replicas as a roughness measurement method recently. This can be considered as a relatively new method; however, there are various replica materials on the market.

Such materials are for example Repliset, Press-O-Film, Technovit which are brand names of special replica materials.

Requirements from the replica material:

- grain size of the replica, and on the basis of this the resolution of replica, reflection of the surface
- curing shrinkage of the replica material,
- curing time of the replica material,
- plasticity consistence,
- homogeneity of the material.

IV. REPLISET REPLICA MATERIAL

Features of the replica material:

- Degree of resolution: from 0,1 micron
- Shrink proof
- Flexibility in a solid state, (Tensile strength: 15-20 kN/m<sup>2</sup>)
- Short curing time
- The material and the method is due to ASTM E 1351 standard
- Curing time: 4 minutes

Parts of the replica set:

- Replica material of two components
- Dispenser
- Mixer
- Sample paper

The process of making a replica:

- Degreasing the surface
- Applying the replica material
- Laying the sample paper
- Detaching the sample

Using the replica material is easy and quick. Due to its flexibility, the material can be easily detached from the sample/out of the sample, so basically it can be applied to any geometry. Based on its definition, it can also be used for measuring burr.

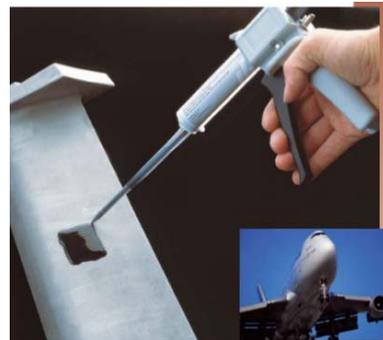


Fig. 4. Repliset replica material, replica set and the final replica

Since its binding time is short, it can be detached from the sample in 1-2 minutes, without any leftover or destruction. Because of its special chemical features, the material sticks only to the paper-like sheet supplied with the set. [6]

The replica material can be examined right after the detachment. The price of the set is relatively low, the method does not require special positioning devices, so it can be usable for measuring burr.

During the examination, we use an etalon which is the same height as the maximum possible height of the burr. Besides this, the replica material can be cut easily if needed, so the cross section of the burr can be examined either with a microscope or any other tools (Fig. 5.).

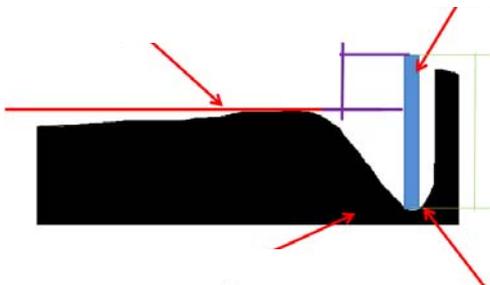


Fig. 5. Possible methods for examining a replica

The replica can be cut by the pink dashed line if needed, so we can examine the cross section easily on the replica.

Among the discussed methods, the polymer replica combined with a microscopic examination can be used the best because it is:

- simple,
- quick,
- cheap,
- usable in the shop floor,
- successful also without the destruction of the part.

## V. CONCLUSIONS

The research in measuring burr on metal parts aims to find such a solution to measure small ( $<0,1$  mm) burrs on the production line with which the part can reliably be qualified. During the research, we especially concentrated on the cap at the end of the neon tube. Among the solutions, one is outstandingly better than the other, as it is not only simple but does not require the destruction of the product. The discussed methods can be used with supplementary devices. Among the methods, the polymer replica can be used the best, as it does not require the destruction of the sample. Moreover, the burr can be measured easily on the replica, and it can be easily destructed for further examinations.

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## REFERENCES

- [1] Móka József: Fine cutting – educational manual, Miskolc, Book, 2006
- [2] Dr. Danyi József – dr. Végvári Ferenc, Sheet metal processing, Kecskemét, Book, 2011
- [3] Jan C. Aurich, David Dornfeld: Burrs - Analysis, Control and Removal
- [4] Dr. Németh Árpád – Fine sheet metal processing – university lecture notes
- [5] Sung-Lim Ko, Won-Sub Kim: Development of Effective Measurement Method for Burr Geometry
- [6] STRUERS – RepliSet System, Replica technique for field applications