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CHARACTERISTICS AND EVALUATION OF SURFACE TEXTURE

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ABSTRACT
The contribution is described analyze of surface texture by 2D and 3D systems, which were measured on real surfaces of work pieces. The surface was evaluated by standard 2D profilometer Surtronic 25 and 3D profilometer Talysurf CLI 1000. Evaluation of surface properties was provided by chosen parameters which describe roughness profile and roughness area surface. It was made their comparing and estimation, for their next development in the research and production praxis. The results show that parameters of area measurements reached higher values, than other similar parameters gained from profile measurement.
Keywords: surface analysis, 2D surface profile, 3D surface topography, surface structure

1. INTRODUCTION
For the evaluation of geometric specifications of products was created a system of assessment and evaluation of surface texture. This is a group of standards dealing with the surface structure, which involves question of content and formal solutions to the problem. Methods of objective assessment and evaluation of surface textures are divided into components according to the spacing of the imperfection. It is the smallest components of the pitch – surface roughness, component called surface waviness and component with the greatest imperfection which is determined by pitch deviations in shape and position of surfaces. The most important component of imperfection is the surface roughness, which is in this paper deal. The surface roughness is the result of the technological process and compares the facts with drawing documentation. Unless specified surface roughness on the drawing or in the schedule, we perform measurements according to specified conditions for periodic or aperiodic profile roughness profile standards [1] [2].

2. EVALUATION OF 2D AND 3D SURFACE ROUGHNESS
The papers dscribes the evaluation method of 2D and 3D surface texture profile applied to the real engineering products labelled with numbers (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12), by these instruments

Surtronic 25, Talysurf CLI 1000 nad their software for evaluation and processing of both measured values as profiles so areal.

3. COMPARING OF 2D AND 3D SURFACE ROUGHNESS PARAMETERS

By instrument Surtronic 25 were carried out preliminary measurements and the measured parameters (2D) profiles were compared with the parameters of drawing documentation. Comparison of measured parameters with the drawing documentation was carried out with regard to the possibility of instrument Surtronic 25 and its software. The samples were divided into two groups and this groups correspond to the values of main and evaluation length [1] [2].
For the first group of samples (1, 2, 3, 4, 5, 6) with the main and evaluation length of 0,25/1,25 Λc / L [mm] and area of 1,25 x 1,25 [mm] was measured at three selected locations of individual samples:

- Talysurf CLI 1000 was carried out three measurements on selected areas (3D) and five measurement of roughness surface profile (2D) by absolute method on selected areas.
- Surtronic 25 was performed the five measurements of surface roughness profile (2D) by relative method on selected areas.

The second group of samples (7, 8, 9, 10, 11, 12) has a main and evaluation length of 0,8/4 Λc / L [mm] and area of 4 x 4 [mm] was performed the same number of measurements as in the first group samples.

4. RESULTS AND DISCUSS

The first group of samples labelled with numbers (1, 2, 3, 4, 5, 6) with the main and evaluation profile length 0,25/1,25 Λc / L mm and area 1,25 x 1,25 mm for measured extents of surface roughness 0,02 μm < Ra < 0,1 μm. By comparing the parameters of 2D and 3D surface roughness measured absolutely and relatively is shown that parameters are comparable. Parameters measured absolutely have higher values than parameters measured relatively. Table 1. shows that a relatively measured parameters are lower due to mechanical filtering effect of the sensor tip.

Table 1. Surface of surface area Sa and surface profile Ra for samples 1 - 6

Surface roughness *Ra and *SaR					
Measured values of parameters of samples are sorted according to parameters of relative measurement form the smallest to the highest value		*2D*		*3D*	
		Relative		***Absolute***	
		Ra [μm]		SaR [μm]	
Sample	*Method of finishing*	ø	±	ø	±
No.2 pump lid	Grounding	0,021	0,004	0,094	0,004
No.6 Iron liner	Lapping	0,027	0,010	0,088	0,004
No.3 pin shan	Grounding	0,035	0,006	0,091	0,002
No.4 piston ring	Polishing	0,040	0,006	0,099	0,005
No.1 ring	Grounding	0,043	0,008	0,099	0,002
No.5 Rod	Polishing	0,075	0,006	0,116	0,006

****Ra**-average arithmetic deviation of profile, ***SaR**- average arithmetic deviation from middle centre of surface area*

Results listed in tab.1 document the relation ship between surface roughness parameters and profile, but for practical use is more appropriate to view (fig.1) the polynomial regression equation of second order to measure the extents of surface roughness 0,02 μm < Ra < 0,1 μm. Regression equation (1) allows accurate conversion of SaR and Ra or conversely with value of reliability R^2=0,895:

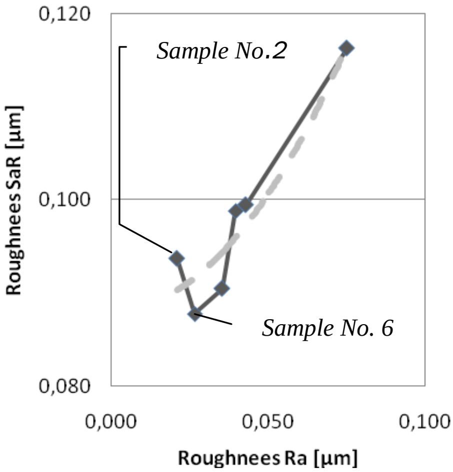

Figure 1. Values of parameters Sa a Ra

$$SaR = 5{,}176 \cdot Ra^2 - 0{,}010 \cdot Ra + 0{,}088 \qquad (1)$$

Graph in fig.1 shows that values of parameters are not in ideal course. It is important to note that concrete parts of from production engineering practice and that is one from of the main causes deviation in displayed areas graph. At the bottom of the graph (fig.1) is biggest occurrence differences from ideal course namely at specimen No.2 (pump cover – ground surface) and No. 6 (Iron liner – lapped surface). One of the biggest influence on these difference in parameters has character surface and that at these samples is different from the type of finishing technological operations.

The second group of samples marked numbers (7, 8, 9, 10, 11, 12) with main and evaluation profile length 0,8/4 Λc / L mm and area 4 x 4 mm for measured extents of surface roughness 0,2 µm < Ra < 2 µm. By comparing parameters of 2d and 3D surface roughness (Tab.2) measured absolutely and relatively it appears that the parameters are comparable. Parameters measured absolutely are more or less values than the parameters measured relatively. From Tab.2 is evident that relatively measured parameters reached lower values which confirmed influence of mechanical filtration on the measured head. Ideal position of stretcher is directly at the place of stylus, bur from practical reasons is stretcher placed in front or behind tip. This ordering causes inaccuracies at scanning some surfaces.

Table 2. Roughness of surface area Sa a surface profile Ra for samples 7 - 12

Surface roughness *Ra and *SaR					
Measured values of parameters of samples are sorted according to parameters of relative measurement form the smallest to the highest value		*2D*		*3D*	
		Relative		***Absolute***	
		Ra [µm]		SaR [µm]	
Sample	*Method of finishing*	ø	±	ø	±
No.7 stem with gearing	Grounding	0,153	0,050	0,169	0,006
No.8 cube	Grounding	0,164	0,010	0,190	0,011
No.9 ring	Grounding	0,274	0,031	0,276	0,028
No.10 injector	Grounding	0,449	0,048	0,383	0,013
No.11 brass ring	Grounding	0,515	0,071	0,404	0,044
No.12 disk	Turning	0,700	0,025	0,618	0,014

****Ra**-average arithmetic deviation of profile, ***SaR**- average arithmetic deviation from middle centre of surface area*

Regression equation (2) allows accurate conversion of SaR nad Ra or conversely with value of reliability R^2=0,988:

$$SaR = 0{,}512 \cdot Ra^2 + 0{,}341 \cdot Ra + 0{,}119 \qquad (2)$$

Differences in the resulting of recomputaton relations measured parameters (1) and (2) show the relative impact of filtration of measured extent. For measuring systems which have baseline created with usage of stretcher is measurement significantly influenced by radius of contact part stretcher and its position. Abnormality in the form of peaks and valleys how on measured area (3D) also on section (2D) decreased with higher value of surface roughness. This valleys and peaks have influence on values of particularly assessed parameters of surface roughness, which are shown in fig.1

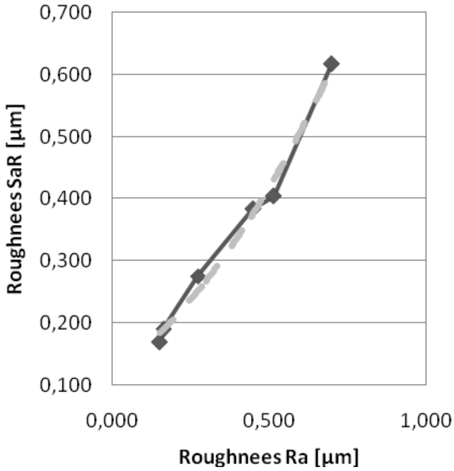

Figure 2 Values of parameters Sa a Ra

5. CONCLUSION

Measurement of geometric surface condition requires performance of series conditions experiments necessary to obtaining correct and comparable results with usage of large number of defined parameters surface roughness, their informative content and relationships. Detailed analysis of systems of evaluation surface texture and processing methods for evaluation of surface texture by 2D and 3D systems has contribution to more objective description of geometric surface condition and its possible effects.

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6. REFERENCES

[1] ČSN EN ISO 4287 - Geometrical Product Specifications (GPS) - Surface texture: Profile method -Terms, definitions and surface texture parameters

[2] ČSN EN ISO 4288 - Geometrical product specification (GPS) - Surface texture: Profile method -Rules and procedures for the assessment of surface texture

[3] Manual - Talysurf CLI 1000, Talymap Platinum

[4] Manual - Surtronic 25, Talyprofile