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SURFACE ROUGHNESS AND DESIGN OF MACHINE DETAILS

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ABSTRACT
The most important pointer in the production of machines and equipment is the surface roughness of the compatible details. The surface roughness type and numerical value substantially impress on the surface contact process, fixes the oil retention and adhesive ability. To define these reasons, we need to research the surface roughness. The resulting information will substantially facilitate to solve a problems of machine building.
In modern machine building for defining the surface is not enough to use two-dimensional (2D) profilograph and arithmetic mean value Ra. For far and wide surface characterization, we need to use three-dimensional surface measurement equipment. Using equipment of these type, will give perfect conception about the surface and its characterizing parameters.
In this case, Machine Building Technology Institute of Riga Technical University obtained the three dimensional (3D) surface roughness measurement machine Taylor Hobson Form Talysurf 50 and some surface roughness sample sets. Using this machine we will do researching of the surface roughness samples. The result of researching will be to elaborate the atlas of the surfaces. In the atlas will be summarize researching results of miscellaneous processing surfaces.
Keywords: surface roughness, three-dimensional measurement

1. INTRODUCTION
Engineering industry and metal working industry evolution are postulates high requirements to the detail lifetime. This requires quality of detail surfaces. Very important surface quality indicator is the surface microtopography. Thus directly impacts on the details mutually contact processes.
Processing surfaces with finishing methods like grinding, polishing, etc., the surface had shape with irregular character surface roughness. Roughness of that kind also incurred in the friction and wearing processes. Surface research by 2D profile methods in this case is imperfection and don't give preferable results. We need to look on technical surfaces like on 3D spatial objects. In this event surfaces are characterized with surface topography and topography parameters.

2. SURFACE TOPOGRAPHY PARAMETERS
How we means previously, 3D parameters are used for surface assessment. Because of 3D surface roughness research is comparatively new field, then currently doesn't exist unitary standard and methodic for developing this task. Only about 10% of all 3D parameters are standardized. Some of them are extrapolation of 2D parameters.
Thereby, because there are many 3D parameters, researchers are developed so-called primary 3D parameters set. In this set are included most important amplitude, spatial, hybrid and functional parameters [3]. These parameters are summarized in table 1.

Table 1. The primary 3D parameter set.

Amplitude Parameters	Spatial Parameters	Hybrid Parameters	Functional Parameters
RMS Deviation **Sq**	Density of Summits **Sds**	RMS Slope **SΔq**	Surface Bearing Index **Sbi**
Ten Point Height **Sz**	Texture Aspect Ratio **Str**	Mean Summit Curvature **Ssc**	Core Fluid Retention Index **Sci**
Skewness **Ssk**	Texture Direction **Std**	Developed Area Ratio **Sdr**	Valley Fluid Retention Index **Svi**
Kurtosis **Sku**	Fastest Decay Auto-correlation Length **Sal**	-	-

There are some problems associated with the determining necessary number of parameters for adequate surface roughness assessment. As it shows practice, some parameters are unusable for various produced surfaces. Some problems in the parameters defining depend on surface topography analysis method. Some parameter values are addicted on the measurement scale. No matter how well the measurement conditions are controlled, parameter values obtained from different measurements vary. New parameters need to be present only when they are necessary and, whenever possible, their 2D counterparts are identified. The sum of necessary parameters defines surface under research production method, assessment method, measuring equipment and measuring conditions.

3. SURFACE ROUGHNESS 3D PARAMETERS MEASURING.

General factor in the 3D surface roughness measurement is selection of adequate methodology. Validity of measurement results depends on measuring methodology. Similarly, one measuring methodic can't apply to all surface types.

At present, there is not standardized methodology for 3D surface roughness measurement, but only guidelines and recommendations. For solving this task we work at the 2D methodology МИ 41-75 (ГОСТ 2789-73) adapting for 3D measuring. Given methodology are provided for following 2D roughness parameters measurement: Ra; Rz; Rmax; Sm; S and tp in metrics system with the contact prophilographs.

Main steps in measurement are following:

- measuring equipment adjustment and sample placing;
- placement of the measurement traces (areas) on the surface;
- choice of measurement area dimensions.

Measuring area displacement needs to be positioned as much as possible regularly along the surface. Fig. 1 shows the measurement traces displacement in 2D surface assessment.

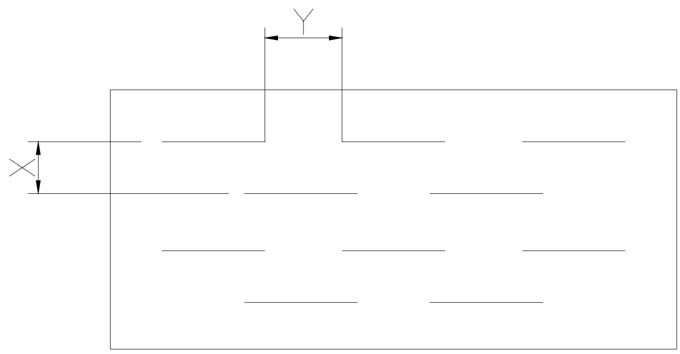

Figure 1. Measuring traces displacement in 2D.

One of the displacement variants in 3D measuring is shown in fig. 2.

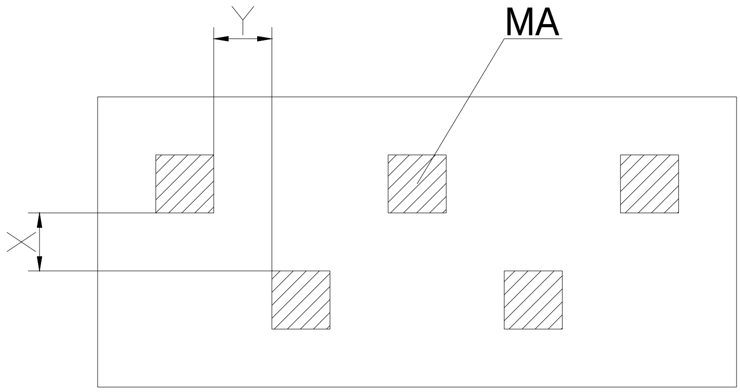

Figure 2. Measuring area (MA) displacement in 3D.

The dimensions X_1 and X_2 relevance are following:

$$X_1 = X_2 \geq 2 \text{ mm}$$

Measuring area length defines table 2.

Table 2. Measuring area lenght

Average roughness Ra, µm	Cut-off length l, mm	MA length L, mm, at least
0.006 ⇒ 0.02	0.08	0.4
0.02 ⇒ 0.32	0.25	1.6
0.32 ⇒ 2.5	0.8	4.0
2.5 ⇒ 10.0	2.5	10.0
10.0 ⇒ 80.0	8.0	32.0

4. REFERENCES

[1] „Методика выполнения измерений параметров шероховатости поверхности по ГОСТ 2789-73 при помощи приборов профильного метода МИ 41-75”, издательство стандартов, Москва 1975.

[2] J. Schmahling, F.A.Hamprecht, D.M.P. Hoffmann. A three-dimensional measure of surface roughness based on mathematical morphology, Technical report from multidimensional image processing, IWR, University of Heidlberg, May 2, 2006.

[3] EUR 15178 EN report