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REPLACING OF PROCESSING METHODS FOR ADVANCED OPERATION OF COMPATIBLE DETAILS

APSTRĀDES VEIDU AIZSTĀŠANA LAI UZLABOTU SALĀGOJUMU EKSPLUATĀCIJU

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Abstract: There are given research results, which show that grinding process of sealing surfaces of compatible joints at finishing stage should be replaced with turning and milling with cubic boron nitride tools. Presently formed new equipment and machines should work in comparatively hard exploitation conditions and it components and details should be with high surface quality, reliability and economy. There was necessity to research governed laws and make analysis, whose can provide high precision and surface quality and thereby durability of involved parts. Thereby for the improvement of exploitation characteristics of coupled parts there was necessity to research surface contact processes. Very important surface characteristic, which determine workability of compatible joint is portance of roughness, and it is very relevant during exploitation of compatible details. Workability of various machines and equipment depends from surface resistance to wearing, surface resistance to adhesion, wearing intensity reduction and increasing of joint sealing. Grinded surfaces with penetrated grinding stone parts intensively wear sealing and make dehermetisation. Wherewith is necessary to replace grinding process with more productively turning and milling together with mutual comparative surface condition.

Introduction

Nowadays science and technology development requires for new, most advanced equipment and machinery, which are able to work in heavy operation conditions, and high precision, surface quality, reliability and economy are the parameters which characterize these machinery. Thereby there are necessary preliminary studies and analysis of conformity to physical laws, which will provide high precision and surface quality and as follows durability of associated details.

For reaching advanced exploitation of moving joined details there is necessity to study contact processes of surfaces. Nowadays theory of contact processes is based on thesis, that surface contact of moving details is discrete and it depends from macro roughness, waveness , micro roughness and seismic roughness deformations. One of most important surface characterizing values, which determine workability of coupling is portance of roughness, and it is very important during designing, technological drafting and exploitation stages [1]. Actual surface contact value is one of surface geometrical characterizing values, which allows solving above mentioned tasks, especially problems, which are involving with prime cost of joined details and exploitation qualities.

Research character and subjects are chosen like this, because nowadays such type of tasks is very urgent, and these requirements are requested for coupled details of various units' exploitation. The work capacity of equipment depends from surface resistance to wear, resistance to adhesion, wear intensity reducing and joint connection compression reinforcement. Joint connection during exploitation becomes loose, and as is find in researches the loosening becomes because during last grinding operations there in surface is pressed shiver parts of grinding stones. The shiver parts of grinding stone which are pressed in surface actively acts on packing material, thereby wear it and to develop depressurizing and emergency situations.

One of most important surface geometry characterizing criteria is value, which characterize surface load carrying capacity. Criteria is characterized by sum of surface profile sections lengths, which is obtained by plane laminating of surface profile in investigated approximation, which is related to base length. The surface micro roughness resistance ability to load capacity characterizes portance of roughness, and it express material distribution in profile depth for detail surface roughness layer. This is also functionally relevant with several

exploitation qualities and embodies surface roughness forms and profile height characteristics also.

Analysis

For now as major method for slip packing and harden coupled rolling surfaces is grinding [2]. As shows experimental investigations, during grinding, shiver parts of grinding stone presses in to detail surface. Wherewith, these abrasive parts start to act to packing and packing material. By the specific efficacy partial packing depressurizes and additional technological environment leaks as well as emergency situations take part.

The research assignment and target was to find technological opportunities for replacing grinding operation with precise equal value machining operation [3]. Accordingly to rapid inspection results, additionally research was done for turning and milling possibilities to replace grinding operations.

In this case machined surface is free of abrasive parts. Wherewith packing and material of packing are not under additional wear conditions.

There was necessity to perform turning and milling of preparation, which was previously under heat treatment, during research. In order to assure it, there was examined possibility to carry out turning and milling of these preparations by cubic boron nitride (CBN HV=7800, t=1400°C) cutters and mill cutters. In this case was necessity to provide same surface characterizing parameters, which was obtained before by grinding.

Turned, milled and grinded surfaces were compared by using various processed surface characterizing parameters: Ra, Rq, Rt, Rz, Rc and RSm, as well as to weight up portance of roughness and frequencies of districts of roughness accordingly to International ISO 4287, Japanese JIS B0601 and American ASME B.46.1 standards.

All machined surfaces were profilographed and established their characterizing parameters, including portance of roughness and frequencies districts of roughness. Research of machined surface geometry was performed by multilateral and compact surface roughness device Rugosurf 10 from Swiss company Tesa technology. Characterizing values of processed surfaces are interpreted in figures 1, 2 and 3.

Condition of surface substantially is characterized by train of parameters. Ra, μm (1) average roughness, arithmetic mean deviation of the profile is the area between the roughness profile and its mean line or the integral of the absolute value of the roughness profile height over the evaluation length. Rq, μm (2) root mean square roughness deviation of the assessed profile or root mean square value of the ordinate values Z(x) within a sampling length:

$$Rq = \sqrt{\frac{1}{l}\int_0^l Z^2(x)dx}\,, \tag{1}$$

where l – sampling length;

Z – ordinate values.

Rt, μm – maximum, total height of the profile, it is vertical distance between the highest and lowest points of the profile within the evaluation length. Rz, μm – average maximum height of the profile points on ten point height of irregularities. Rc, μm – mean height of profile irregularities or is the distance between the average of all peak heights from the mean line and the average of all valley depths from the mean line:

$$Rc = \frac{1}{m}\sum_{i=1}^{m} Zt_i\,, \tag{2}$$

where m – number of profile peaks;

Zt_i – height of the i-th profile element.

RSm, μm mean spacing between profile irregularities or mean width of the profile elements is equal to the mean wavelength of the peak valley cycles. Besides all before mentioned parameters there is portance of roughness and frequencies districts of roughness also. Surface condition characteristics, which are shown in figures 1 and 2, indicates that grinding surface condition (figure 3) might be equally substituted. Larger value of mean spacing of profile irregularities even make better oil involving of micro profile.

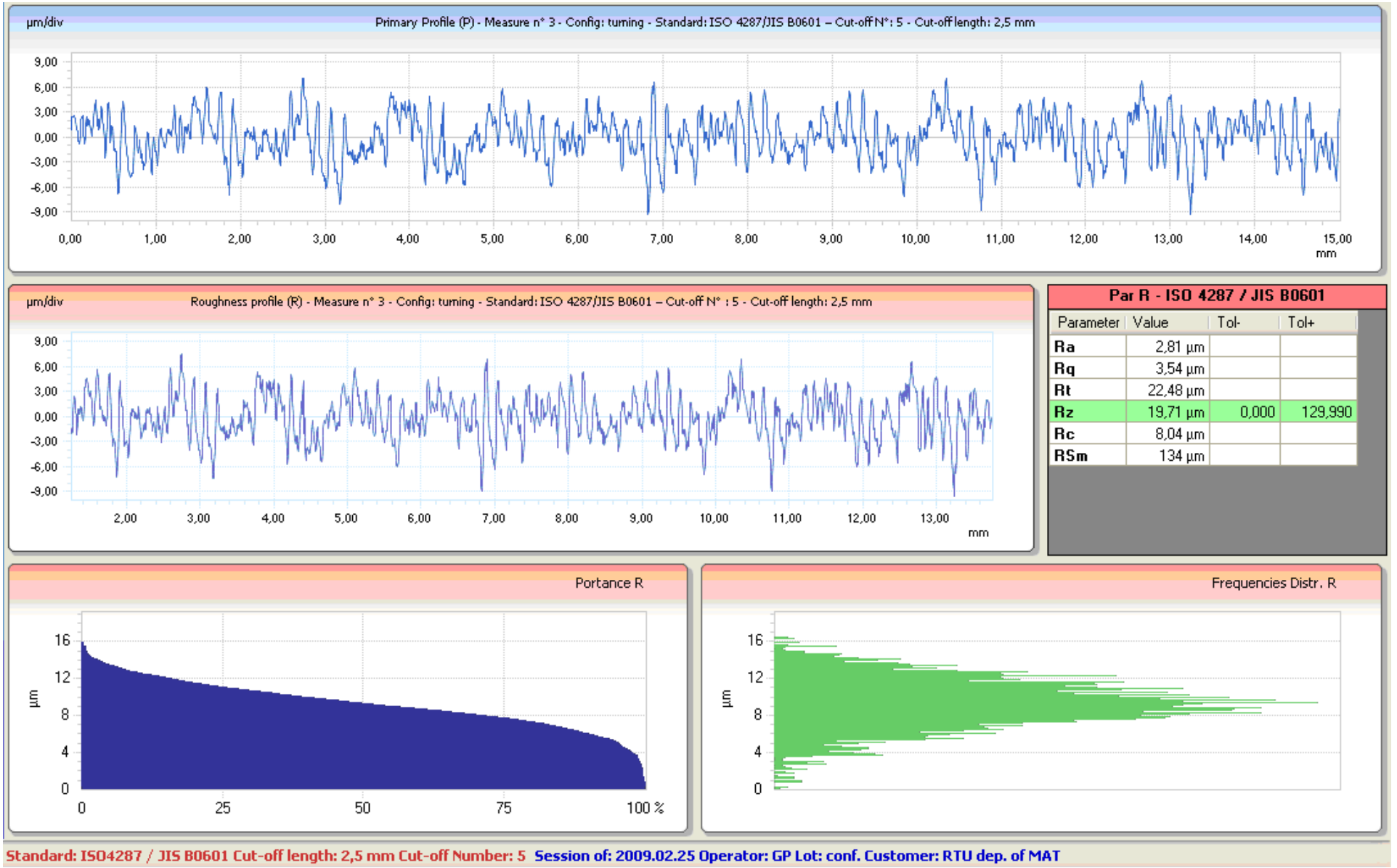

Fig.**1**. Results of turned surface analysis

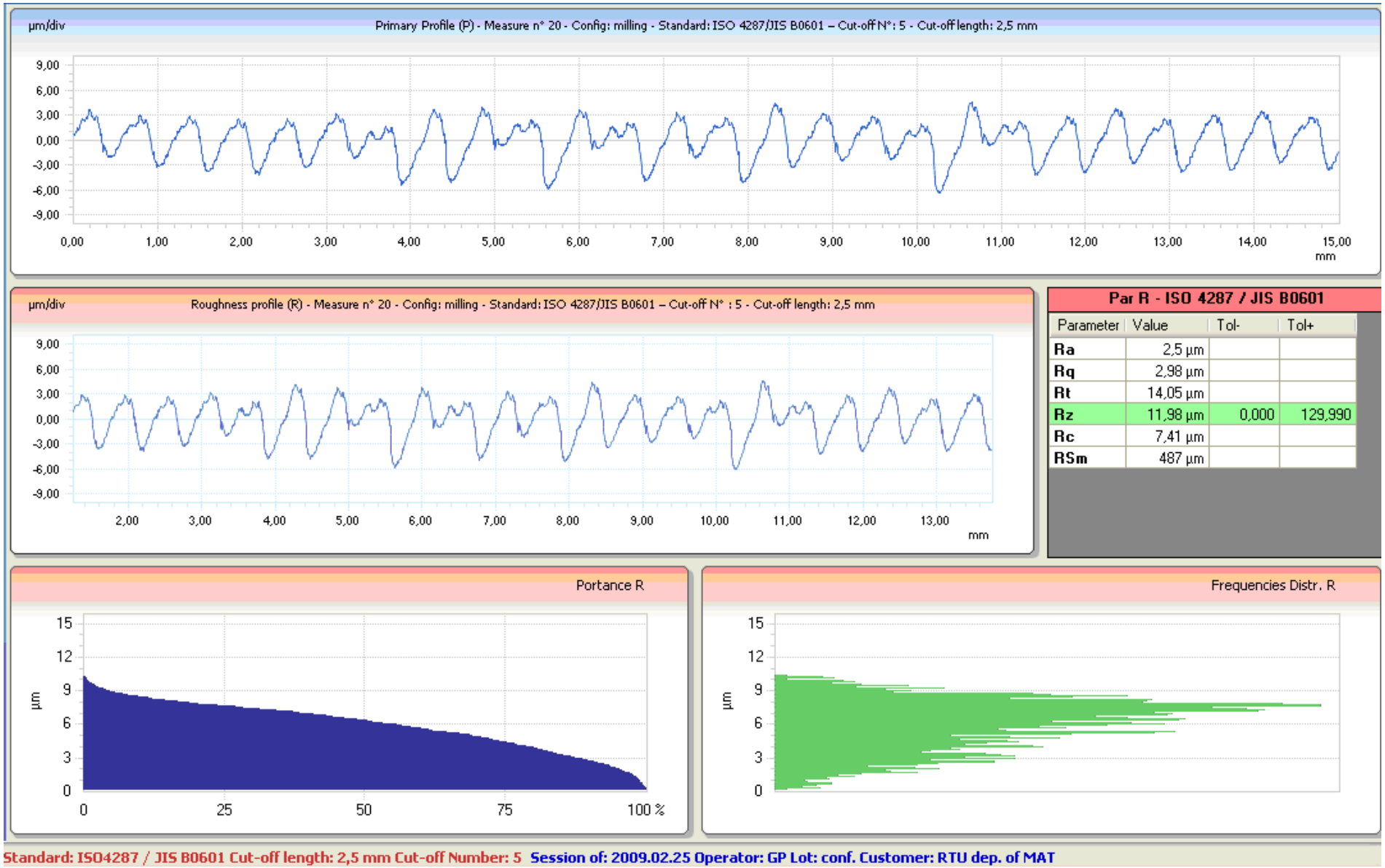

Fig.**2**. Results of milled surface analysis

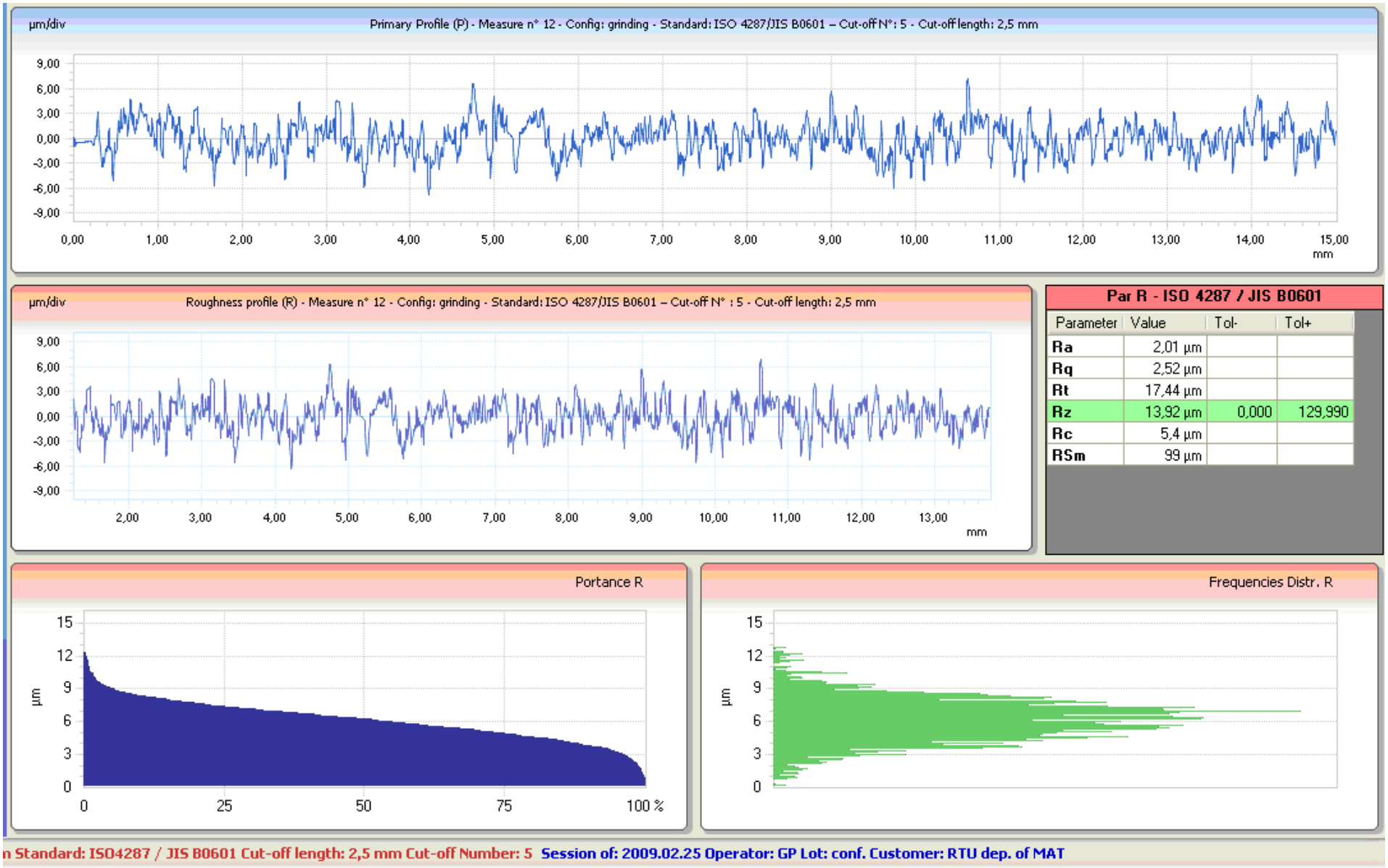

Fig.**3**. Results of grinded surface analysis

Conclusion

Performed research shows that portance of roughness is associated with surface geometry and its exploitation quality. Researches indicate that portance of roughness should be indicated and provided mandatory, during designing and technological drafting, because it is important and indispensable geometrical parameter. Surface is characterized not only by micro topographical surface roughness parameters: arithmetic mean deviation of the profile, ten point height of irregularities, total height of profile and mean spacing of profile irregularities, but also root mean square deviation of profile – Rq, mean peak to valley height of profile – Rc and frequencies districts of roughness.

Grinding stone smithereens, which are penetrated in to details surface, activate wearing and dehermetisation during exploitation. Wherewith is necessary at finishing stage to perform turning or milling with cubic boron nitride tools for tempered surfaces. Processing methods, which are mentioned above with three included figures provide equivalent surface geometry and characteristics as well as portance of roughness and frequencies districts of roughness. Thereby turning and milling equivalently substitute grinding, which also have one and half times lower machining productivity.

References

1. Fritz A.H., Schulze G. Fertigungstechnik. – Berlin, Heidelberg, New York: Springer – Verlag, 2004. – S.479
2. König W., Klocke F. Fertigungsverfahren. – Berlin, Heidelberg, New York: Springer – Verlag, 1999. – S.471
3. Bunga G., Geriņš Ē. Apstrādes ar atdalīšanu tehnoloģijas. – Rīga: RTU, 2007. – 85 lpp.

Bunga G., Pikurs G. Apstrādes veidu aizstāšana lai uzlabotu salāgojumu ekspluatāciju

Sniegti izpētes rezultāti, kuri norāda, ka detaļu noblīvējumu virsmu noslēdzošās apstrādes gaitā slīpēšanas procesu nepieciešams aizstāt ar virpošanu un frēzēšanu pielietojot kubiskā bora nitrīda instrumentus. Pašreiz veidojamām jaunajām iekārtām un mašīnām jādarbojas samērā smagos ekspluatācijas apstākļos un to detaļas raksturo augsta virsmas kvalitāte, drošums un ekonomiskums. Bija nepieciešama iepriekšēja dažādu likumsakarību izpēte un analīze, kura nodrošinātu augstu precizitātes un virsmas kvalitāti un līdz ar to arī saistīto detaļu ilgizturību. Lai uzlabotu darbībā saistītu detaļu ekspluatācijas īpašības bija nepieciešama virsmu kontaktēšanās procesa izpēte. Ļoti nozīmīgs virsmas raksturojums, kurš nosaka salāgojuma darbaspējas ir raupjuma relatīvā atbalsta lielums, kurš ir ļoti svarīgs salāgojuma ekspluatācijas laikā. Dažādu iekārtu darbaspējas iespaido virsmu nodilumizturība, virsmu pretošanās spēja adhēzijai, izdiluma intensitātes samazināšana un salāgojumu noblīvējuma paaugstināšana. Noslīpētās virsmas ar iespiestām slīpgraudu daļiņām intensīvi deldē blīvslēgus, tos dehermetizējot. Līdz ar to nepieciešams slīpēšanu aizstāt ar ražīgāko virpošanu un frēzēšanu, nodrošinot savstarpēji salīdzinātu virskārtas stāvokli.

Бунга Г., Пикурс Г. Замещение видов обработки с целю улучшения эксплутации соединений

Представленные результаты исследований указывают на то что при окончательной обработке уплотненых поверхностей деталей процесс шлифования следует заменить на точение и фрезерование инсрументом из кубического нитрида бора. Ныне разработываемым установкам и машинам придется работать в довольно тяжелых условиях эксплуатации и притом эти поверхности характеризует высокое качество поверхности, надежность и экономичность. Здесь было необходимость в предварительних исследованиях и анализа закономерностей которие влияет на обеспечивании високой точности и поверхностних качеств одовременно и обеспечивая долговечность сопряжённых деталей. Чтобы обеспечить эксплутационные качества сопряжённых деталей было необходимость в исследовании поверхностных контактних процессов. Весьма значимой характеристикой поверхности, которая оределяет работоспособность сопряжения является относительная опорная величина шероховатости, и это очень важно в ходе эксплуатаций сопряжения. На работоспособнось разнообразных установок влияет также износостойкость поверхностей, сопротивляемость повехностей процессу адгезии, уменшенная интенсивность её износа и повышенная уплотняемость сопряжения. В шлифованной поверхноти в процессе обрабоки внедренные остатки шлифзерна интенивно изнашивают уплотнение, вызывая дегерметизацию сопряжения. В связи с этим необходимо заменить шлифование на более производительное точение и фрезерование обеспечивая сопостовляемый поверхностный слой.