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## Dynamic Forces in Unstable Cutting during Turning Operation

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**The theory of self-excited vibrations (chatter) in machining, formulated in the 1950s, assumes a single cutting force. The assumption of a single cutting force in unstable cutting is commonly accepted to this day. In this paper, we will present the reader and listener with a hypothesis concerning the effect of several dynamic forces acting on unstable cutting during turning operations. A new form of the force model will be presented. The calculation of stability limit as well as accuracy of the prediction of stable cutting conditions depends on this model. The validity of the hypothesis has yet to be demonstrated. Preparations for verification experiments have been under way for approximately one year and the experiments will start this year (2014). The hypothesis is based on the results of some earlier measurements of the dynamic forces by foreign authors as well as one of the authors of this paper, Miloš Poláček.**

**Keywords:** Chatter, Complex Dynamic Cutting Forces

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## Evaluation of Adhesive Bond Strength Depending on Degradation Type and Time

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Owing to the evolution an adhesive bonding technology can be a complement of the classical methods as well as their compensation in the area of the bonding materials. Although the adhesive bonding technology has many advantages there are also some limits that contain an adhesive degradation which leads to the lowering of a strength function. In this study specimens were prepared with methyl-methacrylate adhesive (MMA) (Novatit - adhesive) and steel sheets, and the effect of degradation conditions at the room temperature on the adhesive bond strength was studied. Part of the specimens was exposed to a dehydration after the degradation time. The results showed that the degradation conditions and also the dehydration have considerable effect on the ultimate strength as well as on the durability of the adhesive bond.

**Keywords:** Adhesive, Methyl-methacrylate, Ultimate strength

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## The Detection of Artificially Made Defects in Welded Joint with Ultrasonic Defectoscopy Phased Array

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The article describes the fundamental physical principles of the ultrasonic defectoscopy Phased Array, which provides new possibilities in the non-destructive testing (NDT) of materials, especially of welded joints. There is a report from the ultrasonic testing of welded joint with ultrasonic flaw detector OmniScan MX2 from the company Olympus NDT. The artificial defects were designed in software ESBeamTool 5 from the company Eclipse Scientific, which simulates the geometrical ultrasonic beams spread. Then, ultrasonic testing was performed at the same welded joint with artificially made defects. At the end, data from both ultrasonic testing were evaluated. The same procedure will be used for the design of ultrasonic inspection TOFD (Time of Flight Diffraction) and Phased Array at welded joints of gas pipelines.

**Keywords:** NDT, Phased Array, ESBeamTool 5.

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## Barkhausen Noise Emission of Surfaces Produced by Hard Milling Process

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This paper deals with influence of tool wear on surface integrity after hard turning expressed mainly through the Barkhausen noise responses. Grinding operations can be sometimes replaced by hard machining (hard turning and milling). Chip separation in hard turning differs from mechanism of chip separation during grinding. For this reason surface integrity expressed in variable terms differs. Surface integrity can be expressed in such term as surface roughness, shape deviations as well as characteristics such as residual stresses, structure transformations, and microhardness alteration. Being so, it can be beneficial to apply the suitable nondestructive surface testing techniques to obtain information about surface integrity expressed in complexity of this term. Nowadays, Barkhausen noise technique is widely used in a variety of industrial applications. This technique is sensitive to stress state as well as microstructure features. For this reason, Barkhausen noise emission is used in this study to reveal magnetic and stress anisotropy developed in a certain stage of tool wear. The paper also discusses very high BN responses associated with the specific aspects of produced surfaces.

**Keywords:** Barkhausen noise, Hard milling, Tool wear

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## Diagnostics of CNC Machine Tools in Manufacturing Process with Laser Interferometer Technology

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**The paper analyses the influence of the feed motion speed  $v_f$  on the value of measured geometric errors of the four-axis vertical machining centre CNC FV-580A with the FANUC 0IMB numerical control system. The tests were conducted with LSP 30 Compact laser interferometer (by Lasertex). Examples of modern, laser diagnostic systems of numerically controlled CNC machine tools were characterised in the article. Self-tracking laser interferometer LaserTRACER, diagnostic appliance LaserTRACER-MT, laser interferometer with XL80 with environmental parameters' measuring module XC80 and with heat sensors along with XR20-W calibrator were presented. Measurement results and their analysis were presented graphically in the form of diagrams and tables. The conclusion section comprises the discussion of the results, summary and deduction.**

**Keywords:** manufacturing, CNC machine tools, diagnostics, diagnostic systems, laser interferometer

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## The Powdered Magnets Technology Improvement by Biencapsulation Method and its Effect on Mechanical Properties

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In this paper the technological process of bonded magnets manufacturing was described. The greatest dangers arising during the process steps that have a significant impact on magnetic, chemical and thermodynamic stability Nd-Fe-B bonded type of magnetic materials were also indicated. The effect of the biencapsulation of Nd<sub>12</sub>Fe<sub>77</sub>Co<sub>5</sub>B<sub>6</sub> powder particles with Ni-P/epoxy resin, phosphate/epoxy resin and Cu/epoxy resin layers on the finale magnets has been evaluated. The production processes in technological terms in original and after improving modification were presented – the technological process taking into account the stage of powder surface etching and the powder particles biencapsulation. It was proved that the preliminary biencapsulation of particles surface before consolidation in some cases significantly improve the mechanical properties of the bonded with epoxy-resin magnets.

**Keywords:** bonded magnets, biencapsulation, Nd-Fe-B magnets, magnetic composites

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## Influence of the Thermodynamic Phenomena on the Optimum Cutting Parameters in Grinding

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**The quantitative and qualitative results of the technological process are mostly determined by the level of finishing operations, which include particularly the grinding. It is characterized by high precision, the accuracy of geometric shape and generally a very good quality of surface. One of the factors to achieve the desired quality of the finished surfaces is in particular the knowledge of the effect of temperature of the contact surface of the grinding wheel and the ground piece. The article specifies the methodology of quantification of the impact of cutting parameters on the temperature of the grinding. Another requirement is the proper choice of other cutting parameters to guarantee the achievement of the required accuracy of dimensions and shape, increased performance and reduction of the contact temperature between the ground surface and the grinding wheel.**

**Keywords:** energy characteristics, cutting parameters, surface integrity, residual stress, quantification of heat and temperature

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## Non-destructive Testing of Welds in Gas Pipelines Repairs with Phased Array Ultrasonic Technique

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The work deals with non-destructive ultrasonic testing of butt and circumferential fillet welds in the repairing of gas pipelines. The new ultrasonic technique Phased Array was used for testing. The article compared the results of Phased Array ultrasonic inspection to X-ray inspection. Experimental samples were taken from real gas pipelines' repairs. It is a circumferential butt joint connecting 2 gas pipelines and 2 other types of circumferential fillet welds occurring during repairs of gas pipelines with pressure steel and steel patch. Experimental testing was conducted on ultrasonic flaw detector OmniScan MX2 by Olympus. Indications of defects in the weld joints obtained by ultrasonic testing are corresponding with the experimental results of X-ray inspection. Experimental results provided information for proposal of manufacture of artificial defects in these samples.

**Keywords:** Phased Array, repairs of gas pipelines, ultrasonic weld testing

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## Effect of Machining the Load Capacity Notched Components

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Nowadays is issue investigation the notch problems and their influence on component durability. For many manufactured components, we find various types of notches, such as grooves, step and holes. They have a tend to be the place where is concentrated stress, so called the macroscopic stress concentrator. In this area is higher risk of part destruction. Nowadays, there are hypotheses that are based on the assumption that the higher the roughness, the lower the durability. In many cases the designers prescribe unnecessarily high surface quality. It is necessary to maintain adequate quality of the surface, and also necessary that the component has attained a high durability. The paper deals with the influence of machining technology carrying capacity of notched components. As the test material was used steel Fe510 according to EN ISO (11523, according to CSN 42 0002).

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## Quality Evaluation of Surface Layer in Highly Accurate Manufacturing

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**Precise characterization of surface topography is very important in many engineering industries. This paper describes potential possibilities of using optical 3D (three dimensional) measurement methods in surface metrology. Surface integrity describes the status and attributes of the machined surface. This paper presents possibilities of using and measurements of surface integrity, namely the surface topography and the physical parameters of which are analysis of microstructure and microhardness of the surface layer.**

**Keywords:** machining, optical microscopy, surface morphology, topography

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## Evaluation of Mechanical Properties of Samples Printed by FDM Method

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**To ensure optimal conditions of instruction in technical subjects it is fundamental to have laboratory trainings where students learn methods of the material measuring and they get pieces of knowledge about a test equipment. Financial cost of samples leads to minimizing laboratory trainings. It can be solved by fused deposition modelling (FDM). The aim of the research was to test a possibility to use test samples made by means of FDM method for an implementation within the practical training. Within the research two standard materials determined for FDM (that means ABS plastic and PLA) were used. Test samples were made / printed by a printer EASY3DMAKER with using a software G3DMAKER. Test of an abrasive wear, a hardness Shore D measurement, a tensile strength and an impact strength were performed for verifying a functionality of the test samples printed by FDM method for laboratory experiments.**

**Keywords:** laboratory training, testing, research, fused deposition modeling

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## Concept of repairing branch pipes on high-pressure pipelines by using split sleeve

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Repairs of branch connections defects on high-pressure pipelines allied to gas-escape are nowadays difficult processes. The reason is necessity of performing sections of damaged pipeline that is connected with transport medium layoff or with using technology of by-pass installing around damaged part of pipeline. In article, a concept of technology of branch connections repairing by split pressure sleeve is presented, which is in recent times realised only at straight sections of pipelines. Concept consist of split sleeve design along with wall thickness optimization in simulation software ANSYS. Concept of internal space of sleeve sealing up from welding workspace using appropriate seals placed at its sealant carriers is presented, too. Dimensions, material of carriers and sealant location were designed according to experimental measure of temperature, together with subsequent validation of heat transfer by numerical simulation in software SYSWELD. Described repairing method concept seems to be an appropriate alternative of branch connection repairing that allows fast and safe correction with lowered operational costs on realisation of repair and possibility of speeding-up and simplifying emergency conditions solution.

**Keywords:** gas-escape repair, pressure sleeve, high-pressure gas pipelines, SYSWELD, ANSYS

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## Influence of Cutting Conditions and Grinding Wheel Wear on Barkhausen noise of ground surfaces

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**This paper is a part of the more detail research focused on the specific problems during grinding of bearing rings of diameters in the range of 600 up to 1000 mm. The paper discusses the specific aspects of surface burn after grinding associated with insufficient coolant feeding as well as the variable grinding conditions. Measurements are based on micromagnetic evaluation of ground surfaces due to large diameter of inspected rings and very fast response of the proposed technique. Magnetic inspection of parts is based of physical phenomenon originating from irreversible Bloch Wall motion well known as Barkhausen noise. Some experiments were conducted in the laboratory of our department (grinding of ring of small diameters) and specific measurements were carried out in the practice (rings of large diameters). This paper also discusses alteration of surface microhardness of ground surface as well as structure transformations.**

**Keywords:** Barkhausen noise, surface integrity, grinding, bearing steel

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## Influence of Adhesives Storing Temperature on Adhesive Bond Strength

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Adhesive bonds are very often applied in various climatic conditions and environments. Each environment is of specific properties which basically influence entire strength and reliability of an adhesive bond. The influence of the surroundings temperature on the strength and service life of the adhesive bond is one of the most important factors which has to be taken into regard by a designer when designing the bond. However, during a transit or a storing the adhesives can meet much higher or lower temperatures than it is recommended by a producer. The aim of the experimental part is a determination of the influence of the storing temperature in the interval -20 to 100 °C on the resultant strength of the adhesive bond. Two-component epoxy and acrylate adhesives which are used as the constructional ones were used for experiments. The subject of the research was the adhesives which are not specially determined for using in high or low temperatures. From the results it is obvious that the packing type is essential for a transfer of surroundings temperature into the adhesive. Higher storing temperatures (temperatures exceeding 60 °C) affect in a negative way the adhesive bond strength.

**Keywords:** adhesive bonding technology, packing, strength, surroundings temperature

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## Influence of AlSi7Mg0.3 Alloy Modification by Sb on the Tool Wear

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**Modifying of alloys is an important part of the metallurgical process and involves the course also of alloys of aluminum, specifically the Al-Si (silumin) in our case. One of the elements that it is possible used to modify for type of alloy Al-Si is antimony (Sb). This paper investigates potential impact of the modification of this element for AlSi7Mg0.3 alloy on tool wear in cutting process. Within experiments were made three casts of master alloy AlSi7Mg0.3 without additional modification and three casts from this ligatures that were more subsequently modified by 0.05 wt% Sb on the cast. These castings were then machined to the same cutting conditions and was assessed the resulting wear of inserts. The present experiment and analysis are part of larger research that are carried out at the Faculty of Production Technology and Management of Jan Evangelista Purkyně University in Ústí nad Labem.**

**Keywords:** modification, alloy, antimony, machining, tool wear

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## Computer Design of Robot ABB IRB 140 Transport System from Manufacturing Point of View

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**This paper presents the theoretical and practical aspects of industrial robots transport systems problems focused on application possibilities connected with concrete type of robotic device. Introduction of the article presents today possibility of robot transport systems and collect information about basic technical parameters of transport systems, their design and construction. Main part describe industrial robot ABB IRB 140, collect information about technical parameters, its construction, axes, motions and applications used in industrial practice. Practical part of paper is focused on proposal of robot transport system design from manufacturing point of view.**

**Key words:** industrial robot, transport system, manufacturing technology

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## Production of ABS-Aramid Composite Material by Fused Deposition Modeling Rapid Prototyping System

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**This paper describes a method of ABS-aramid composite material production by Fused Deposition Modeling Rapid Prototyping System. In the beginning there is presented common technology of parts production by Fused Deposition Modeling method of Rapid Prototyping. Then it deals with the theoretical description of proposed concept production of ABS-aramid composite material by Fused Deposition Modeling method. In the main part it describes an experimental testing of proposed concept at the Faculty of Manufacturing Technologies in Presov in the laboratory of Rapid Prototyping. For creation of sample bodies using the FDM method of RP we used the combination of basic ABS material reinforced by aramid tissue. At the end it summarizes possible trends of further development and research in described area together with possibilities of industrial applications.**

**Key words:** rapid prototyping, fused deposition modeling, composite material, experimental testing

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## Identification of machinability of ceramic materials by turning

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**Paper deals with the machining of super-hard ceramics by turning. The introductory part deals with analysis of used ceramic materials and their use in technical practice. Since it is a very hard technical ceramics and particularly resistant material, at present, is increasingly used to produce components that ensure long life and particularly high resistance, even in aggressive environments where metal materials can no longer be used. Products from ceramics are pressed and sintered directly to the desired shape, but in some cases they have to be machined, which technically can cause a problem. The aim of the experimental part is selection of suitable cutting insert, determining of cutting conditions that would ensure the productive machining of given ceramics. Work may serves as a troubleshooting support for machining ceramics.**

**Key words:** Industrial ceramics, diamond cutting disc, super-hard materials.

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## Effect of the Inclination Angle on the Defining Parameters of Chip Removal in Rotational Turning

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**The efficiency of the machining processes, the accuracy of the manufactured parts, and the quality of the machined surface are determined by several factors: the tool geometry, the parameters that affect the kinematic relations, and the cutting parameters. Therefore it is necessary to investigate the effect of each characteristic parameter on the technological parameters in the research of rotational turning. In this paper first we sum up the geometric and kinematic relations that affect the defining parameters of chip removal. We give an overview of the parameters which must be given in rotational turning. We briefly show the method used for the mathematic-analytic definition of these parameters. After that we determinate and analyse the alteration effect of the inclination angle on the resultant axial feed, on the theoretical arithmetic mean deviation and on the characteristic parameters of the chip cross-section.**

**Keywords:** rotational turning, chip removal characteristics, inclination angle

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## Practical Application of Quality Tools in the Cast Iron Foundry

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**New requirements placed to products, and hence to materials from which they are produced resulted in widespread use of instruments of quality assurance. Depending on destination of the product, its manufacturing process is burdened with the need to implement quality assurance systems, recording and analysing data, and also a process of continuous improvement. The article presents the results of practical use of selected quality tools in iron foundry. In order to determine the level of incompatibility of manufactured products the analysis was carried out based on the use of Ishikawa diagram and Pareto-Lorenz method. The results of the above analysis were defined as a starting point to develop a dendrogram and to determine the variant solution to the problem using programming of decision-making process, there was also developed diagram of the manufacturing process of iron castings.**

**Keywords:** Quality Tools, Cast Iron Foundry

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## New experimental Dependence of Machining

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**During the application of recent relationships between cutting conditions and results of machining there occur unevennesses, which can lead to incorrect choice of cutting conditions in concrete conditions of machining of engineering parts. Equations used in practice and on the base of wide experimental analysis to optimise their shape are being analysed in the paper. It concerns the evaluation of chip compression, machined surface microgeometry and cutting tools durability.**

**Keywords:** machining, tool durability, cutting conditions, machined surface quality

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## Finite element analysis of crack growth in pipelines

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The paper presents a short crack theory together with the finite element method (FEM), which is used to model crack initiation during the operational phase of a pipeline. To simulate the crack, the virtual crack extension (VCE) method, implemented in the FE code, is used. This paper describes the modelling and simulation of a welded pipeline with initiated crack in the beginning. A FEM modelling procedure for analysing the stress intensity factors (SIF's) and J- integral for two practical problems is presented. For the first problem the commercial software ANSYS was used to calculate the crack parameters in a straight pipe with a radial crack. The second problem deals with an axial crack tip in the main pipe of a welded tubular Y-joint. For this problem numerical results for calculated crack parameters and contour integrals are presented. The parameters were calculated by commercial software ABAQUS. For J-integral evaluation, the region on the surface of the blunted notch should be used to define the crack front.

**Keywords:** FEM, XFEM, stress intensity factor, J-integral, pipelines

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