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## Content





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## Content

# Structural Design of Blocking Element of Magnetic Cycloid Transmission

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**The contribution deals with the study of magnetic structures, computational methods used in analyzing the interaction of magnetic fields with application this knowledge in practice.**
**The main object of study is design of blocking element of magnetic cycloid gearbox. This paper describes the design methodology of magnetic blocking element, calculation of the braking system, the maximum breakaway torque at slipping in magnetic coupling and power ratios during this action.**

**Keywords:** blocking element, stress analysis, visualization

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# Meaning of Quality Inspection and Control Methods during Manufacturing Process of Metal Sheet Stampings

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**The paper presents the characteristics of a metal product called 'Back Cover' and its manufacturing process. The characteristic of quality inspection methods and control devices during manufacturing process of analysed product was conducted. An analysis of production and quality problems during manufacturing of the analysed product using qualitative and quantitative tools such as Ishikawa diagram and Pareto-Lorenz diagram were presented. Ishikawa diagram was used to identify areas that generate quality problems and Pareto-Lorenz diagram was used to quantify the quality problems and to distinguish the critical nonconformities. It was presented differences between visual control and visual inspection. BOST research was used to determine the validity of the use of visual control in the analysed company against the remaining factors of the manufacturing process. Created a series of validity of manufacturing process to capture the relationship between the place of the individual factors of the manufacturing process. The use of visual control turned out not to be the most important factor in the manufacturing process, according to the examined company the most important is the use of only reliable technology.**

**Keyword:** manufacturing process, 'Back Cover' part, quality inspection methods, visual control, BOST method

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**Paper number: M201547**

# Increasing the Production System Productivity Using Inertial Navigation

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**The paper addresses the integration of the inertial navigation unit implemented into the system of controlling the robot. It analyses dynamic properties of the sensors of the inertial unit, e.g. gyroscopes and accelerometers. The implementation of the original system of controlling the robot on the basis of autonomous navigation systems into the production system is a dominant part of the paper.**

**Keywords:** production system, controlling, inertial navigation, robot

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# Application of Laser Shock Processing

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**Laser Shock Processing (LSP), or strengthening the material surface by laser shock wave is very modern and progressive technique, which allows a significant increase in fatigue life of cyclically loaded parts. The compressive residual stresses are generated in the surface layer of material processed by laser beam, which can significantly improve the fatigue properties of the material and reduce the initiation and propagation of the surface cracks. This technique finds practical use of the most demanding applications like in the aerospace industry. For this reason, we are mapping the selected surface properties after the laser treatment for the better understaning of technology possibilities. After that another suitable applications can be found. It is also important to determine appropriate parameters for different types of material and requirements affecting the result.**

**Keywords:** Laser shock processing, surface integrity, residual stress

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# Spruce Plywood Bonding

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**The contribution contains results of bonded joints strength tests. The tests were carried out according to the modified standard CSN EN 1465 (66 8510). For bonding the spruce three-ply wood of 4 mm thickness was used (according to CSN EN 636). The test samples of 100 x 25 mm size were cut out from a semi-product of 2440 x 1220 mm size in the direction of its longer side (angle 0°), in the oblique direction (angle 45°) and in the direction of its shorter side (crosswise - angle 90°). The bonding was carried out using eight different domestic as well as foreign adhesives according to the technology prescribed by the producer. All used adhesives were designated for wood bonding. At the bonding the consumption of the adhesive was determined. After curing the bonded assemblies were loaded using a universal tensile-strength testing machine up to the rupture. The rupture force and the rupture type were registered. Finally the technical-economical evaluation of the experiments was carried out.**

**Keywords:** bonding, adhesive, bonded joints testing, costs of bonding

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# Inovative Methodology for Hot Tears Analysis in the Aluminum Castings

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**Hot tears represents serious defects, which are in most cases considered as unacceptable and may even result in disposal of final casting. The cause hot tear initiation is mainly a combination of several mechanisms (incorrect mold construction, chemical composition of used alloy, purity of used alloy, casting process conditions etc.). Basic principles of hot tears initialization can be considered relatively clarified, but a comprehensive and coherent view is still missing. The goal of proposed project was to design a coherent system to analyze emerging hot tears in the aluminum castings. The proposed mechanism is based on a number of concepts - a combination of "dog bone" and "T-section" tests. During the experiments will be possible to record the temperature at critical points, a tensile force in shrinking casting and by using heat-resistant glass placed above the heat node will be possible to directly observe the tears. Initial experiments will focus on verifying the functionality of the apparatus, the aim will be to analyze the impact of the solidification interval on hot tears.**

**Keywords:** Hot tear, Aluminium alloy, Solidification interval

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# Insights for the Selection of the Machining Parameters in the Turning of Difficult-To-Cut Coatings

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**Usually, the coatings used in industrial applications require post-processing to reach their final shape. However, some of these coatings are difficult-to-cut, mainly because of their high hardness. The present study provides a revision of some experimental investigations on the turning of WC-Co, Stellite, and Fe-based and NiAl alloys. The materials are used for both coatings and sintered workpieces providing insights for conducting turning tests. For the success of the turning process, the selection of the machining parameters is a critical issue. Based on the reviewed investigations, the surface roughness is clearly influenced by the feed rate, expecting higher values than the ones predicted by the theoretical equations. Besides, the increase of both the cutting speed and feed rate leads to a high tool wear. Likewise, the increase of the feed rate leads to higher machining forces. In general, the influence of the cutting speed and depth of cut is less evident. Regarding the machining parameters, usually their maximum values are fixed at low levels: 100 m/min, 0.35 mm/rev and 0.3 mm, for the cutting speed, feed rate and depth of cut, respectively.**

**Keywords:** difficult-to-cut coatings, machining force, machining parameters, surface quality, tool wear, turning

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# Surface Treatment Technologies for Wear Resistance Increasing of 42CrMo4 Steel

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**The present study was directed to investigate the mechanical and tribological properties of 42CrMo4 (CSN 41 5142.3) steel, which was thermochemical treated by the technologies of tenifer, manganese phosphate and plasma nitriding combining with blackening. Plasma nitriding was carried out for the samples under different condition of gas mixture under temperature of 480ºC (plasma sputtering) and 500ºC (plasma nitriding process) for 10h. Besides determining the microhardness (HV 0.05), surface hardness, and microstructure, this paper also concentrates on the field of wear resistance evaluation and friction coefficient of these surface treatments. Based on "ball on flat" test, calotest, and profile observation, it was found that tenifer technology is suitable to increase the wear resistance, and manganese phosphate improves clearly not only wear resistance but also friction coefficient, which can be usable for weapon production.**

**Keywords**: Wear resistance, Friction coefficient, Plasma nitriding, Tenifer, Manganese Phosphate

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# The Assessment of Selected Mechanical Properties of Steel after Application of Plasma Nitriding

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**The article deals with mechanical properties of plasma nitrided steel. Experimental work was focused on evaluation of influence of plasma nitriding process to notch toughness of steel, the experimental were realised on V-notch samples of size 10x10x55 mm (according to CSN ISO 148-1 standard). Nitrided layers were applied to steel 30CrMoV9 which were subsequently evaluated by metallographic, GDOES and microhardness method. The notch toughness tests of steel were carried out using the instrumental Charpy hammer at temperatures -40 °C, +21 °C and + 70 °C. The results of experiments showed that plasma nitriding process has a direct impact on change of notch toughness parameters. The notch toughness of plasma nitrided steel was significantly decreased. The measurements thereinafter showed that values of notch toughness at low temperature (-40 °C) decreased but also at higher temperature (+70 °C). It was found a dependence of notch toughness values of plasma nitrided steel between the testing temperature and plasma nitriding process parameters.**

**Keywords:** Plasma Nitriding, Notch Toughness, V-notch

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# Structural Characteristics of Cr-Mo Steels Microalloyed with Cerium

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**The results of an experimental study on influence of cerium addition on structural characteristics of 42CrMo4 steel are presented. Alloying with cerium was carried out using profile filled with powdered mixture of mischmetal. The samples were taken from two ingots cast in the VHM's steelworks with standard time of casting of about 14 minutes. Three steel bars from one of the produced ingots were prepared by forging. Chemical composition, macro- and microstructure, X-ray EDX chemical microanalysis, hardness of the all steel samples were obtained. Cerium addition resulted in the formation of micrometer size inclusions which can be utilized for controlling the grain size structure of steel castings. The majority of the particles have settled at the bottom part of the casting, indicating that the convection flow during solidification was very weak. The cerium addition slightly diminished hardness of the steel. A segregation phenomenon causing inhomogeneous distribution of cerium over entire volume of as-cast samples after relatively rapid crystallization process of the steel was revealed.**

**Keywords:** CrMo Steel, Cerium, Microstructure, Interaction, Microsegregation

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# Experimental Investigation and Analysis of Cutting Forces When Machining X5CrNi18-10 Stainless Steel

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**In this study, cutting forces experimental measurement an analysis with special carbide insert when turning austenitic stainless steel have been investigated. Stainless steel X5CrNi18-10 is often considered as poorly machinable material. In this experimental study a number of turning tests carried out by using a test lathe and a cutting force measuring device are presented. Accordingly the effect of cutting speed and tool insert cutting geometry on cutting forces in turning austenitic stainless steel X5CrNi18-10 (AISI 304) using Wiper cemented carbide tool insert has been discussed. The effect of cutting parameters (feed rate, depth of cut) is also analyzed by cutting forces measurement. The input parameters were varied as $v_c$ = 100 m.min$^{-1}$, $f$ = 0,150 and 0,275 mm and edge geometry $\kappa_r$ = 95°, $\kappa_r'$ = 5°, $\varepsilon_r$ = 80°, $r_\varepsilon$ = 0, 8 mm, $\lambda_s$ = -6°. The results show that main cutting force $F_c$ decreases with the increasing of cutting speed in turning without using the coolant. A benefit for production process also confirmed fact that this growth is 2,5 to 3 times higher as for turning of CS0E4 under the same machining conditions due to the hardening of austenitic steels for chip creation. It was also noted that experimental specimens showing larger cutting forces then generated worse surface finish as well as larger surface damage.**

**Keywords:** Austenitic stainless steel, Cutting forces, Cutting parameters, KISTLER measuring device

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# Effect of Spindle Unit Extrusion on Stability of Machining Process

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**Dynamic characteristics of a machine-tool-workpiece system are not constant during machining, but they can be changed by a variable spindle position, a rising tool wear or a gradual change of a workpiece geometry. This paper deals with an influence of spindle unit extrusion on stability of a machining process. Two milling cutters with different rigidity, flexible and stiff, were used for experimental machining at three axis milling machines. Clamped milling cutters were extracted systematically and a frequency response function was measured simultaneously. Reached data (natural frequency and dynamic compliance) were used for finding a correlation between dynamic parameters and extrusion of the spindle. Critical extrusion of the spindle unit was predicted by an experimental measurement and an axial depth of cut thresholds was established for the stable machining.**

**Keywords:** Vibration, spindle, stability, extrusion, dynamic compliance

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# Optimization of Overmolding Process of Metal-Plastic Part

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**Metal-plastic parts with steel inserts prepared by overmolding technique showed several cracks. Cracks marked as no 1 and 2 were noticed immediately after overmoulding process. Cracks no 3 and 4 were propagated only several days after overmolding, during post crystallization of plastic. The superposition of both high residual stresses at the metal-plastic interface and creation of cold joints in overmolding plastic were the reasons of cracks initiations. Residual stresses at the metal-plastic interface exceeding the yield strength of plastic were confirmed by simulation in Moldflow software. The differences in the melt front temperature above 20 °C were simulated in the critical areas where the cold joints created in the real metal-plastic parts. Cracks no 1, 2 and 3 were eliminated by increasing of plastic thickness in the critical areas. Cracks no 4 were eliminated by decreasing of packing pressure, what also contributed to the elimination of cracks no 3.**

**Keywords:** metal-plastic part, overmolding, crack, cold joint, residual stress

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# The Research Results in the Area Of Environmental Taxation of Manufacturing Business Entities in the Czech Republic

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**The paper deals with the current topic of environmental taxes on the level of the Czech Republic. The urgency of the topic is highlighted by the dynamic international development of environmental taxation and continuous unification within the European Union. Environmental taxes affect the final consumers of solid fuels, electricity and natural gas and some other gases. The paper researches the impact of environmental taxes on a selected group of manufacturing business entities which are largely consumers of products taxed by environmental taxes. This type of taxes represents a part of corporate environmental costs and as such it is necessary to manage these costs. At first the paper examines the influence of environmental taxes on the enterprise performance after their introduction into the Czech tax system in 2008 and then there are proposed the indicators for monitoring and management of environmental taxes as a part of the enterprise costs. The influence of environmental taxes on business entities is researched by the profit and loss report item "consumption of material and energy", the economic result, rentability of assets indicator and also by the proposed material and energy costs rentability indicator. Further there are proposed two other ratio indicators for environmental taxes monitoring within the corporate costs which can also serve as one of the criteria for investment decision-making of an enterprise. For the correct quantification of the proposed indicators a reference accounting timetable is drafted which includes the environmental taxes analytical evidence and their integration into the corporate accounting.**

**Keywords**: costs management, environmental tax, environmental costs, enterprise performance introduction, manufacturing business entities

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# Non-Destructive Experimental Method for Determination of Modulus of Elasticity of Hydraulic Hoses

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**This article deals with a non-destructive experimental method for determination of modulus of elasticity of hydraulic hoses. There is described experimental equipment for determination of the modulus of elasticity of hydraulic hoses by expansion method. The modulus of elasticity is determined for several hydraulic hoses of different parameters on basis of combined hydraulic capacity of oil and hose. Furthermore it is necessary to know oil bulk modulus. The modulus of elasticity of hoses is very important during design of a hydraulic system. It is necessary to take into account the modulus of elasticity of hoses in a mathematical simulation model of dynamic parameters of a given hydraulic system. A designer can subsequently utilize maximal flexibility, maximal stiffness or required ratio of the mentioned hose properties. The measured hose isn´t destructed and can be subsequently used in hydraulic systems. It is a big advantage of this method.**

**Keywords:** Modulus of Elasticity, Hydraulic Hose, Oil, Non-Destructive Method.

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# Numerical Study on Effect of Narrow Groove On Hot Bearing Ring Rolling Process

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**Ball-section raceway groove and narrow groove ring (BGNGR) is a complex part of bearing rings. The mandrel for the forming of the narrow groove will push and press the metal and lead to instability of the rolling process. Therefore, the effect of the narrow groove on the metal flow is investigated. Two methods for BGNGR rolling are presented, and by deducing the dimensional relationship between rectangular blank and deformed ring, the finite element models for both methods are established and simulated in Forge3D software. Method I is proved to be a failure through the finite element analyses of the effect of the narrow groove on the metal flow. Based on the analysis result in Method I, the Method II with appropriate mandrel profile for the going up metal is proposed. The simulated result shows that the BGNGR whose geometry size meets the requirement can be rolled by Method II.**

**Keywords:** Narrow groove, Blank sizes design, Metal flow, Ring rolling, FEA

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# The Effect of Cutting Temperature on Carbide Drilling Life in the Process of CFRP/Steel Stacks Drilling

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**The fiber reinforced plastic (CFRP) are widely used in stacks with metallic materials. The parts are usually bolted together during assembling procedure. That is why drilling is one of the most widely used operations for machining of CFRP/metal and metal/CFRP stacks. That allows to obtain components, which combine high strength and low weight. This paper presents tool wear study based on the drilling experiment of CFRP/ steel stack. The most common problems of CFRP/metal stacks machining are CFRP delamination, fiber pull – out, thermal degradation and intensive tool wear. Last decade such parameters of CFRP/metal stacks drilling as axial force and torque are in the focus of researches. However, the cutting temperature in the drilling process of CFRP/metal stack and its influence on drill bit wear is still not fully gained at the present time. The purpose of current study is to investigate the effect of cutting temperature on the tool life of carbide drill. The temperature was measured with K type thermocouple which was embedded on the flank surface of the drill. Axial force was measured with dynamometer. Data of cutting temperature and axial force was digitalized with analog – digital converter (ACD) and visualized on personal computer (PC). The dominating tool wear mode when drilling CFRP/steel - was flank wear which was measured with optical microscope. The experimental study of cutting temperature effect on the tool wear of carbide drill was established. It was found that the most unfavourable combination of stack materials in the conditions of drill wear is CFRP/metal.**

**Keywords:** Composite Materials, Stack, Drilling, Cutting Temperature, Wear, Tool Life

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# The Determination of the Shelf Mass in the Universal Shelving Stacker by Measuring the Frequency Converter Torque Generating Current of the Main Drive

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**The correct determination of the shelf mass including content is very important for the proper function of a universal shelf stacker (USS) drives life and construction USS so that these elements were not overloaded. Weighing can be done by direct methods using various sensors tension and compression but also the indirect method, by the torque sensing of current frequency converter, which controls the speed of the three-phase asynchronous motor. This method does not require any additional construction or adaptation or additional sensors or electronic evaluation system power operation. Weighting method of shelf in USS is based on the fact that the torque converter current is proportional to the sum of the weight of the shelf and the extractor and its value provides almost every frequency converter. In contrast to the direct weighing method of the shelf it is obvious economic advantage of this method and the accuracy is sufficient for the operation of USS.**

**Keywords:** Indirect measuring, Stacker, Warehousing, Weighting

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# Effects of a Cutting Fluid on Aerosol Size Distribution during Turning

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**Cutting fluids are complex mixtures used to cool, lubricate and remove metal chips from tools and metal parts during grinding, cutting, or boring operations. Utilization of cutting fluids in the technological process of metalworking often generates aerosols which represent a significant hazard to the safety of workers and to the environment. The paper deals with the research of cutting fluid's impact on aerosol production by expressing particle size distribution. We used a special image analysis algorithm for the data obtained by a high-speed camera to determine the particle size. The procedure of result assessment was created for measuring the size of small droplets and it was implemented in a MATLAB application. Multifactor analysis of variance (ANOVA) and nonparametric analysis of variance were used for statistical result evaluation.**

**Keywords:** Cutting Fluids, Aerosol Particle Size, Image Analysis, High-speed Camera

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# Material analysis of damaged breech locking element of machine gun

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**Weapons are special systems, which have high demand in terms of reliability, safety and durability especially in the case of automatic weapons. The most stressed parts of weapons are barrels, breech, locking elements etc. This paper si focused on the failure of locking element, which is used for set the breech baffle and for locking of the breech. From the structural point of view the locking element is highly dynamically stressed component. During the shooting cycles are the shocks transferred into these components, therefore specified material requirements of the locking element are needed. The material of locking element must be modified to hard surface with tough core with thickness corresponding to the size and frequency of shocks to prevent the fatigue failure. The manufacturing documentation wasn´t available, therefore the chemical analysis was performed using the GDOES/Bulk method. The results were compared with material standards to determine the Czech steel equivalent. The damaged locking element was metallographically tested, the surface and microhardness testing was performed by Vickers method. The fracture surface morphology was using the light and electron microscopy (SEM) observed.**

**Keywords:** Locking element, material analysis, failure

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# Compressive Creep Testing of Composites on the Based of $MoSi_2$ – SiC Nanoparticles

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**The aim of this study is to investigate the creep resistance of molybdenum disilicide ($MoSi_2$-SiC) based composites with different types of embedded particles. The materials were prepared via powder metallurgy using high temperature controlled reaction sintering (CRS). The creep experiments were performed in uniaxial compression at constant stress in the temperature range from 1273 K (1000 °C) to 1473 K (1200 °C) for applied stress from 50 to 100 MPa. Creep was tested by stepwise loading: in each step, the load was changed to a new value after steady state creep rate had been established. The applied stress dependences of the creep rate at different temperatures were analyzed in terms of stress exponent (*n*) and activation energy (*Q*). Possible rate-controlling mechanisms were suggested.**

**Keywords:** $MoSi_2$-SiC, creep test, compressive creep, stress exponent, activation energy

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# Cutting Tool Wear Monitoring

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**Cutting tool wear monitoring is one of key problems in automation of machining processes. Apart from the cutting tool wear monitoring for the cutting tool change and cutting tool failure, cutting tool wear monitoring may be one of the components for the adaptive control of a machining process. This paper is focused on the design of turning cutting tool wear sensors of the system flap – jet principal with increased extend. On the geometric principles in cutting with a turning cutting tool, the relations among the output of jet mouth, clearance angle and cutting tool wear were expressed. Two variants of turning cutting tool sensors were designed and experimentally verified. The results of experiments have proved the possibility to apply cutting tool wear sensor of the system flap – jet principal with increased extend in practical use.**

**Keywords:** Machining, Cutting tool wear, Monitoring.

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# Design Theory for Screw Geometry in a Briquette Press

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**This paper focuses on the structural design of screw tools in briquetting presses used for the production of solid, high quality, bio fuels. The primary objective is to analyse the screw tool geometry and determine a procedure for its design, specifically the theory involved with the pressing tool and force relations which are necessary for the verification of the proposed tool geometry and its strength analysis. In designing the main drive of the press, procedures for determining frictional performance of the screw press are used. Familiarity with the above mentioned procedures forms the basis for research into new tools in screw briquetting presses that will improve the service life and competitiveness of the technology.**

**Keywords:** biomass, briquetting, tool, screw, screw profile

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# Research on Constructional Shape of Bond at Connecting Galvanized Sheet of Metal

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**A constructional shape of an adhesive bond deals with a mutual position of bonded parts in such way to gain a given contact area. The constructional shape of the adhesive bond finds a practical application at connecting of plain areas that means sheets of metal above all. The adhesive bond strength at connecting the galvanized sheet of metal was significantly lower than at connecting a constructional carbon steel. Results of specimens of wavy-lap bonds showed higher values of the adhesive bond strength comparing with specimens of single-lap bonds. The wavy-lap constructional adjustment proved to be positive at connecting the galvanized sheet of metal. The increase of the adhesive bond strength ranged in the interval 27 to 560 %. The difference in using specimens A (single-lap bond) and B (wavy-lap bond) is obvious from the statistical comparison. It is visible from performed experiment that using the specimen B (wavy-lap bond) led to increasing of strength values of the adhesive bond.**

**Keywords:** Adhesive bond, deformation of adherent, two-component epoxy adhesives, testing

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# Investigations of Cutting Tool Wear While Machining Inconel 718

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**This contribution describes the progress of wear and influences contributing to wear of a cutting tool during straightturning of the Nickel superalloy Inconel 718 according to W. Nr 2.4668. According to the ISO 513 standard this alloy belongs among heat resistant materials; it is a special Nickel alloy used primarily for machine parts in the aircraft industry. The experimental part was done for the purpose of testing suitability of proposed exchangeable cutting inserts intended for machining of Inconel 718. Mechanisms and magnitude of wear and durability of the tools were determined in accordance with the ISO 3685:1993 standard in order to evaluate suitability of the proposed tools.**

**Keywords:** Inconel 718, machining, cutting tool, durability, mechanism and criteria of wear

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# Characteristics of Plasma Nitrided Layers

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**This article deals with mechanical and chemical properties of nitrided layers which were created by plasma nitriding technology. The aim is to achieve an enhanced surface hardness, better wear resistance, reduced friction coefficient, increase fatigue limit or corrosion resistance. Experiments are focused on using of plasma nitriding process for surface treatment of cavities with diameter of 6 mm. Nitrided layers were applied to steel PO 209 which were subsequently evaluated by metallographic, GDOES, XRD microanalysis and microhardness methods. The results of measurement showed trends of chemical composition of alloying elements after chemical-heat treated process in cavity. Plasma nitriding process is applied for increasing of surface hardness of material in deep cavities. Mechanical properties of tested material were significantly increased. Surface hardness and microhardness is depended on content of nitride formed alloying elements in material.**

**Keywords:** nitriding; microhardness; nitrided layer; Nht thickness.

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# Reaming of Very Precise Holes in Hydrostatic Component

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**Nowadays, one of the motive trend in engineering industry is transportation and manipulating technology. The hydrostatic mechanisms belong to the most important components and are created by hydraulic engines, pumps, switchgears etc. Inseparable part of hydraulic engine is a servo-valve which coordinates the fluid flow by a microscopic movement of piston. The servo-valve is a casting, usually made of ductile cast-iron that is necessary to machine. The functionality of hydrostatic circuits is influenced significantly by the precise movement of pistons.Therefore it is necessary to provide the dimension accuracy, machining quality and also the geometric shape of holes. This article describes the issue of holes reaming in hydrostatic components with a use of reamers made of sintered carbide and cermet.**

**Key words:** hydraulic engine, reaming, sintered carbide, cermet

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# Testing of Implant Prototype of Femoral Component Using Hydraulic Machine ZD40

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**An article deals with a realization and a statistical evaluation of a pressure test using a hydraulic testing machine ZD 40 in order to determine a strength of a designed implant prototype of a femoral component, more precisely a maximal force F that breaks a material and creates a crack. It is needed to make real testing samples of the new implant prototype of the femoral component for this purpose. Four pieces of testing samples are made in cooperation with the company in Velka Bites. Because of a price and availability in a range of offered cast materials testing samples are made of a bio tolerated cobalt alloy Co-Cr-Mo that is frequently implanted to a live organism. The implant prototype of the femoral component is designed from evaluated CT data of a patient's affected knee-joint (a femur distal part, a proximal tibia part). An individual 3D model of the implant prototype of the femoral component is created on the basis of editing of gained data in software CATIA.**
**The created 3D model is converted to *.stl format with a high resolution. Subsequently, the shell implant of the femoral component (a master model) is made using an additive method FDM (Fused Deposition Modelling). The next production method follows – production of a ceramic mould and casting of the real implant prototype of the femoral component from the bio tolerated cobalt alloy Co-Cr-Mo.**

**Keywords:** Knee-Joint, Implant Prototype, Femoral Component, CATIA, Hydraulic Machine

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# Deposition of Aluminium Oxide ($Al_2O_3$) Coatings on Aluminium Substrate Using Anodizing Processes.

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**The aim of this paper is to describe anodizing technology for deposition of $Al_2O_3$ coatings on Al substrates. Various methods of layer deposition were used for the experiments. Deposition was carried out in acidic environments, using sulphuric acid ($H_2SO_4$) and chromic acid ($H_2CrO_4$). Several samples were heat treated (annealed). Chemical composition of the substrate and the coating was tested by GDOS method using SA2000 and GDS 500A devices. Surface morphology and structure were evaluated by SEM, using VEGA5135 electron microscope. Selected mechanical properties as thickness, microhardness and adhesion were also determined.**

**Keywords**: coatings, aluminium oxide, microhardness, surface morphology

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# Operational Risk Management and Treatment af Technical Systems with Maintenance Support

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**The purpose of this paper is to describe the area of risk management, in which maintenance can positively contribute to risk reduction and suggested reliability methods and maintenance tools can be used for risk treatment. The authors define the relationship between critical failure and risk and influence of preventive maintenance and redundancy on risk level. The risk level is defined as a product of critical failure probability and cost of critical failure losses. The proposed method enables to quantify risk treatment results. Benefits of the proposed risk treatment method based on preventive maintenance and redundancy applications are risk reduction and decreased costs (losses) of critical failure consequences within chemistry and nuclear power industrial technology. All decisions of maintenance have to be assessed according to economic criteria for specific objects and conditions in order to choose proper system maintenance.**

**Keywords:** Maintenance, Risk Management, Preventive Maintenance, Redundancy, Risk Treatment

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# The Modification of System for the Angle of Attack Setting at Roller Rig RAILBCOT

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**The aim of the article is to present suitable changes at the conception of the angle of attack setting mechanism and the modification of the spring element at the load module SIMRAIL, part of roller rig RAILBCOT which faithfully simulates the behavior of the vehicle on a real track. RAILBCOT is the acronym for RAIL vehicles Brake COmponents Test stand. During the measurements were recorded imperfections, which could influence continuous testing, and would lead not to reliable and fully trusworthy results. The article describes three steps to improve the situation. The first step describes the stabilization of the members to prevent the occurrence of clearance. In the second step were started measurements at the roller rig at different operating speeds. In the third step is modified the angle of attack setting mechanism where was mechanical spring element changed by hydraulic spring element. Mentioned is also the need for increasing the stiffness of the spring element, which lack of stiffness caused loss of stability before the requesting speed. Modified was the gear lever, where was changed the transmission ratio and dimensioning of spring element.**

**Key words:** RAILBCOT, SIMRAIL, test stand, rail vehicle brakes, simulation computations

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# Material Analysis of 120 mm Mortar Projectile Stabilizer

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**The article deals with the evaluation the state of 120 mm mortar projectile stabilizer. It assesses a crashed projectile, whose stabilizer got stuck in the barrel during the shot. The evaluation includes the analysis of the mechanical properties, especially hardness, besides the evaluation of cracks, structure and chemical composition of the materials used. Cracks are documented with Olympus GX 51 optical microscope and Tescan Vega TS 5135 electron microscope. The chemical composition was assessed by EDS method on the Noran System Six/300 device. The hardness values of the stabilizers were obtained by LECO LV800AT hardness tester, the microhardness measurement used LECO LM247AT equipment. Material properties and microstructure evaluation was compared with the documents available in the metallurgical laboratory of the Department of Mechanical Engineering.**

**Keywords:** 120 mm mortar projectile stabilizer, woody crack.

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**Paper number: M201577**

# Design of Experiments for CNC Turning

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**This paper follows on research on published in the Journal of the Academy of Business & Economics [1] (authors Hron and Macak) and complements previous research on the area of design of experiments using a factorial design. Further results are compared between Fuzzy Logic and Design of experiment approaches.The main purpose of this paper is to compare the results between the mathematical model of optimization of CNC turning and the optimization using the fuzzy-logic method for multi-criteria optimization of cutting conditions. The comparison in this paper verifies these two approaches. In the case of an inconsistency, the objective of this paper would be to suggest a new approach where the incorporation of the mathematical model (as an approximation form) and the optimization of fuzzy-logic would be consistent.**

**Keywords:** Design of experiments, cutting conditions, fuzzy logic, the surface roughness of workpiece.

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# Dependability Characteristics – Indicators for Maintenance Performance Measurement of Manufacturing Technology

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**Authors define general dependability characteristics (reliability, maintainability, supportability and availability) and their measures. Further there is introduced method of data collection which shall be planned taking into account appropriate targets. Dependability data analysis needs clear understanding of an object, its operation, environment and physical attributes to be obtained required dependability measures which are described. These measures can be used as indicators for measuring maintenance impacts on reliability and maintainability. Data collection and its evaluation help to monitor the impact of maintenance on these indicators. Dependency between non-fulfillment of preventive maintenance and failure intensity including maintenance costs are also evaluated.**

**Keywords:** Maintenance, Reliability, Availability, Preventive maintenance, Fulfillment of maintenance

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# Barkhausen Noise Emission of Surfaces after Laser Beam Machining

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**This paper deals with analysis of surface integrity of steel after laser beam machining (LBM). The paper discusses surface integrity expressed in term of rms values of Barkhausen noise and reports about variables affecting Barkhausen noise emission such as laser power, gas pressure, thickness of machined surface, focus distance and feed speed. The paper demonstrates variable degree of surface hardening due to elevated temperatures and the following rapid cooling. Except magnetic investigation of surface also stress state and structure observation are reported. This study demonstrates that thickness samples takes major role from the point of surface integrity expressed in structure transformations as well as stress state whereas influence of focus distance and gas pressure are only minor. Medium degree of surface integrity transformation can be driven by variation of laser power and feed speed.**

**Keywords:** laser beam machining, Barkhausen noise, surface hardening

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# Influence of Surface Treatment of Steel Adherends on Shear Strength of Filled Resins

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**Adhesion of resins and adhesives to adherend is one of the important characteristics, including the area where the resin or adhesive is filled with particulate fillers in order to optimize this adhesion, achieve other mechanical characteristics or in order to reduce the price of the resulting resin or adhesive. When discussing filled resins with particulate fillers, these materials can be defined as a polymer composite systems. Surface treatment of adherend before applying such a filled resin, is crucial to the overall strength of this interface. Blasting is commonly used kind of surface treatment of metal adherends. Properly chosen blasting conditions and achieved roughness parameters are crucial to the overall strength. The experiment describes the impact of the changing conditions of blasting on the shear strength of epoxy resins filled with glass powder. The results of the experiment show that the highest shear strength on steel adherend was achieved when the surface was blasted at an angle of 60 - 90° (12.93 ± 0.62 MPa). The roughness parameters Ra and Rz were influenced by a specific kind of blasting material ($Al_2O_3$ F80 and glass beads B10), which has also a considerable influence on shear strength.**

**Keywords:** Blasting, corundum, epoxy resin, glass beads, glass powder.

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# Test Stand Dynamics Properties Investigation by Means of Simulation Computations

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**The paper is devoted to the mechanical system dynamic properties investigation of the test stand RAILBCOT (RAIL vehicles Brake Components Test stand). Using sensors attached to some parts, have been measured values of positions, the longitudinal, vertical and transversal forces, revolutions and accelerations. There was created computational model of the mechanical system in SIMPACK software system environment. There were performed model establishment, starting and boundary condition setting and simulation computations to determine the dynamic properties parameters. The measured values were compared with calculated values. Subsequent verification has been confirmed the necessity of modification of the flexible member of the bench. The paper consists of issue definition and the comprehensive references specification from the field of investigation of working team at the University of Žilina relevant to this field of study.**

**Keywords:** test bench, multibody system dynamics, RAILBCOT, SIMPACK, simulation computations

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# Question of Optimal Cutting Speed for Machining by Conventional and Coated Cutting Tools

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**The paper dealt with tool-wear, tool-life and chip creation regarding the cutting speed for machining by conventional and coated tools. The cutting speed is influenced by several parameters. The determination of optimal cutting speed is challenging question. Situation is more complicated in case of coated tools. The important is criterion of optimization. Moreover, the presence of the coating changes chip creation process and stress state during cutting. The paper provides complete experimental $T$-$v_c$ dependencies obtained in turning regarding various parameters as depth of cut, feed for different machined and cutting tool materials. Paper describes also different tool-wear mechanisms of uncoated and coated tools. Finally, the paper analyzes stress state in tool as simplified model of contact of tool rake and chip for conventional and coated tools involving different mechanical properties of coating and substrate material, temperature and different thicknesses of coatings.**

**Keywords:** cutting conditions, turning, tool wear, coating

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# Analysis of Fiber Orientation Influence to Dynamic Properties of Composite Structures

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**In modern analysis of structures it is not only important to study structures subjected to static loading but also to study the effects of dynamic loading. One of the results of impact loading is the dynamic response of structures. This can cause far more damage than the effects of static loading. Composite materials are more and more used in engineering praxis. This allows the creation materials of high strength at low weight which are more durable then the same construction made of homogenous materials. This paper presents a study of dynamic response of carbon fiber reinforced polymer composite plates in the form of modal analysis and transient response (subjected to unit pulse point load in the center of the plate). The plate consists of layered uniaxial carbon fiber fabric and the layers are layered symmetrically at different angles for various variants. The response in the form of displacement magnitude is measured. At the end a comparison study is presented for each analysis.**

**Keywords:** Finite element method, Composite Materials, Carbon Fiber Reinforced Materials, Response of Structures

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