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## Brazing Operation for Aluminium Semi-Products by Heat Treatment

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Nowadays, there is an effort to increase the economic effectiveness, including manual work, from the aspect of the modernization of production technologies. The brazing operation is one of the operations requiring skills and experience and therefore, the paper deals with modern brazing technology of aluminium alloy semi-products which are heated only in the electric furnaces. Application of heat can lead to the formation of the perfect join of semi-products based on such materials as A 3004 and AA 4045. A thin layer called Clad is deposited on one component of the AA 4045 material while the mentioned thin layer is molten to the prescribed temperature in the furnace but the most important fact is that there is not occurrence of melting in relation to the base material. After cooling, Clad creates a perfect metallurgical join between the joined surfaces. The resulting microstructure corresponds to silumin alloy. The transition between silumin alloy and aluminium matrixes of the component is continuous and without any defects in the form of discontinuities or pores and this fact was confirmed by the evaluation of the microstructure. This technology is used in the production of battery coolers in electric hybrid cars. Tightness of brazed join is controlled by pressure and helium tests. Analysed cooler was suitable from the aspect of the performed testing procedures.

**Keywords:** cooler, aluminum alloys, silumin, brazing.

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## Evaluation of Ride Comfort for Passengers by Means of Computer Simulation

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**An important aspect of rail vehicle dynamic analysis is a ride comfort analysis and a prediction when passengers and cargo can experience adverse conditions. The computational software utilisation helps to determine forces and accelerations in various positions through the body of the rail vehicle in order to predict ride properties or evaluate ideas for ride comfort in advance. This paper is aimed to the dynamic simulation of the rail vehicle running on a real track. The rail vehicle model creation, computations performance and determination of accelerations badly needed for the ride comfort evaluation is performed by SIMPACK package. Parameters of passenger rail vehicle model correspond to the four-axle two-bogie BR481 rail vehicle. The track model on that the vehicle has been run corresponds to the real track section in Slovakia.**

**Keywords:** Ride comfort, Rail vehicle, Computer simulation

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## The Effect of Plasma Nitriding Process on the Change of Dynamic Parameters of Steel DIN 1654/4

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This article describes the effect of selected parameters of plasma nitriding on the change of dynamic parameters of steel DIN 1654/4. Plasma nitriding is currently used in a wide range of technical applications such as a final operation to improve the mechanical properties of components. This experimental investigation is devoted to the analysis of the influence of plasma nitriding on the notch toughness of structural steel DIN 1654/4 (CSN 41 2042.4). The test of the dynamic fracture behaviour of structural steel was carried out using by instrumental Charpy hammer on the plasma nitrided specimens with V and U notch, manufactured according to standard CSN ISO 148-1. The plasma nitriding was implemented at 500 (°C), process duration  $t = 10$  and 20 (h) and variable gas mixture ratio of 24H<sub>2</sub>: 8N<sub>2</sub> (l/h) and 8H<sub>2</sub>: 24N<sub>2</sub> (l/h). The test results showed that nitrided steel has become more brittle. However, it was found that for different gas composition, the notch toughness has behaved quite diversely. The values of notch toughness of steel in case of gas ratio 8H<sub>2</sub>: 24N<sub>2</sub> (l/h) were decreased but for gas ratio 24H<sub>2</sub>: 8N<sub>2</sub> (l/h), with extension of time, the notch toughness was slightly increased.

**Keywords:** Plasma nitriding, Notch toughness

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## Measurement and Analysis of Mass Flow and Abrasive Sieving Impact on Technological Head Vibrations during Cutting Abrasion Resistant Steels with Abrasive Water Jet Technology

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The article presents the results of Technical University in Košice Faculty of Manufacturing Technologies Department of production processes operation and Technical University in Ostrava Physics Institute Liquid jet workplace cooperation in the area of operational states diagnosis of manufacturing systems with abrasive water jet technology (AWJ). Within the operational states diagnostics is the impact of selected technological parameters on technological head vibrations studied. Based on an extensive set of experiments are original graphical dependences determined of the abrasive mass flow and abrasive sieving impact on the vibrations parameter - technological head vibrations acceleration amplitude of manufacturing system with AWJ technology. In addition to the original graphical dependences are in article new knowledge formulated in the area of science and research and recommendations for companies that operates manufacturing systems with AWJ technology.

**Keywords:** Casting HARDOX 500, Cutting, Hydro-abrasive water jet, Abrasive mass flow rate, vibrations acceleration amplitude

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## Use of Parametric 3D Modelling - Tying Parameter Values to Spreadsheets at Designing Molds for Plastic Injection

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The current mechanical engineering is inconceivable without the implementation of CAx systems in design and manufacturing process of individual components. The automotive industry is a clear evidence of how CAx systems affect the innovation cycle of its product - a car. The innovation cycle in automotive was reduced from 8-12 years to the current 4-6 years. Even in this short interval automakers make some small design modifications called a facelift. Development in the automotive industry, therefore, is closely related to news and functionality CAx systems. CAD systems at the turn of the millennium are characterized as parametric graphic systems with a history tree of product creation. Parametric design implemented into CAD systems makes the model variable and open to rapid change management. The history tree in turn enables rapid editing and modification of forming or editing functions.

**Keywords:** CAD, 3D, parametric modeling, mold

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## The Influence of High Temperature Loading on the Structure of Fine Al Powder Compacts

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Aluminum specimens for pilot resistance testing at higher temperature and mechanical loading were prepared by means of powder metallurgy. The aluminum powders with nanooxide surface layers were prepared. The tests were performed at 300°C and applied stress of 100, 125, 150, 175 MPa and at temperatures 350°C and 400°C and stress of 100 MPa. Aluminum specimens tested at 300°C and stresses of 100 and 125 MPa were characterized by very high resistance. Similar resistance was exhibited by specimens tested at 350°C and 100 MPa. The rupture of specimens tested at 350°C at 150 and 175 MPa was initiated mainly from surface defects. By aluminum tests at temperatures below 400°C, compact oxide layer was not disturbed. Oxide layer fragmentation at 400°C resulted in lower resistance of aluminum specimens. The resistance increase was accompanied by higher portion of ductile fracture with dimpled morphology. Large angle grains size was not changed. Higher temperatures and stresses cause dislocation netting on grain boundaries and initiate subgrains formation.

**Keywords:** aluminum powder, nanooxide layer, thermal resistance, dislocation netting

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## The Heat Treatment of Aluminium Bronzes

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Aluminium bronzes can find use in many engineering applications thanks to their excellent properties, predominantly high corrosion resistance, good ultimate tensile strength, fatigue strength and creep strength. Yet, their mechanical properties can still be improved, most importantly by appropriate heat treatment. The type of heat treatment is typically chosen with regard to the desired properties of the product and its service conditions.

This paper attempts to summarise the microstructural changes which take place in aluminium bronzes during heat treatment. Another objective of this study was to map the potential of a certain type of aluminium bronzes for undergoing martensitic transformation. The methods, which were chosen for assessing the results of heat treatment with regard to their availability, included measurement of hardness and observation of microstructure using light and scanning electron microscopy. Additional tools for evaluation of microstructure comprised measurement of microhardness and chemical analysis by EDS.

**Keywords:** Aluminium bronzes, Heat treatment, microstructure, EDS

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## Long-term Sub-zero Treatment of P/M Vanadis 6 Ledeburitic Tool Steel – a Preliminary Study

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**The microstructure, the phase constitution and the tempering charts of Cr-V ledeburitic steel Vanadis 6 subjected to sub-zero treatment with various soaking times in liquid nitrogen have been investigated. The microstructures have been characterized using the light microscopy, scanning electron microscopy and X-ray diffraction. The hardness has been evaluated by Vickers method. The matrix is martensitic with certain amount of retained austenite, irrespectively to the time of sub-zero treatment. The amount of retained austenite, however, decreases up to the soaking time of 17 h and then remains almost constant. The microstructure of sub-zero treated steel contains enhanced portion of small globular carbides, as compared to conventionally heat treated material. These particles have a size of around 100 nm in most cases. The as-quenched hardness manifests a moderate increase due to the sub-zero treatment. The hardness decreases during subsequent tempering and this decrease is more pronounced in sub-zero treated samples.**

**Keywords:** Cr-V ledeburitic steel, sub-zero treatment, retained austenite and martensite, carbides, hardness

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## Changes of the Surface Texture after Surface Treatment HS6-5-2-5 Steel

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Texture of the surface is very important in process reproduction of the components. Not only in engineering area, but also in other industrial sectors, the assessment of the surface texture ranks among basic techniques of the determining the surface properties of the component. Pretreatment of the surface can reduce running costs in the case of coating on the tools. The paper describes the changes of the surface textures of the HS6-5-2-5 steel CSN EN ISO 4957 with different technological treatments of the substrates, coating and subsequently polishing of the coating. Substrate was sandblasted (wet) and polished before coating. Coating nACo® was applied by PVD method and surface of the coating specimens was subsequently polished by  $\mu$ Lap method. Surface textures together with properties of the coating are decisive factors for their lifetime and durability of the cutting tools. The qualitative assessment of the changes surface texture was carried out by the 3D topography measurement of the surface by using Talysurf CCI Lite. TalyMap software was used for evaluation of the changes surface texture. For evaluation of the surface were used parameters: Sa - arithmetic mean deviation of the surface [ $\mu$ m], Sdq - root mean square slope of the surface [-] and Rk - core roughness depth [ $\mu$ m]. The results in the paper demonstrate positive effect of the polishing on texture coating on the tools.

**Keywords:** Surface textures, Coating, Parameters of the surface textures, Polishing, Sandblasting

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## The Influence of Heat Treatment on Mechanical and Corrosion Properties of Wrought Aluminium Alloys 2024 and 6064

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**This article deals with the influence of the alloy temper during heat treatment on mechanical and corrosion properties of aluminium alloys 2024 (Al-Cu-Mg) and 6064 (Al-Mg-Si). For the experiment initial alloy tempers 2024-T351 and 6064-T8 were heat treated to three conditions – underaged, peak aged (T6) and overaged – to simulate the circumstances during the manufacturing process. Structure of all conditions and tempers was observed. The mechanical properties – hardness, yield strength, ultimate strength and elongation – and corrosion properties – maximum depth of corrosion attack penetration and corrosion rate in Audi immersion test for automotive industry (internal standard PV 11 13) – were measured. Structures of investigated alloy show evidence of intermediate phases arrangement in the direction of plastic deformation and they do not change during heat treatment. The lowest hardness, yield strength and ultimate strength have the underaged samples, the highest hardness, yield strength and ultimate strength have peak aged (2024) or initial samples (6064). Elongation decreases with ageing time or ageing temperature. In case of alloy 2024 corrosion rate and maximum depth of corrosion attack penetration increase with ageing time or temperature, in case of alloy 6064 corrosion rate increases with increasing ageing time or temperature while maximum depth of corrosion attack penetration decreases. Both alloys are attacked by intergranular corrosion with initiating surface pits.**

**Keywords:** Aluminium alloys, heat treatment, precipitaton hardening, corrosion and mechanical properties.

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## Non-contact Study of Surfaces Created Using the AWJ Technology

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**Spatial measurement and evaluation of the surface profile parameters provide valuable and useful information about the relationship between the geometric characteristics of the surface and its functional properties. Evaluating the structure of surface area may help to explain a variety of problems in manufacturing technologies as it allows detailed quantitative study of geometric and dimensional changes of the surface profiles. AWJ cutting still generates unrevealed questions regarding interactions of the cutting material with the work-piece. The article presents experimental study of surface of steel material after AWJ cutting with usage of optical method that was selected as universal method that overcomes some of the shortcomings of contact methods.**

**Keywords:** abrasive water-jet cutting, profile parameters, roughness, non-contact measurement, striation

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## Corrosion Resistance of Plasma Nitrided Structural Steels

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The plasma nitriding technology was mostly used in the past primarily to increasing of surface hardness a fatigue limit. Additional feature of nitrided steel surface is possibility of corrosion resistance increasing. This additional feature is leading to the increase of lifetime of steel parts and components. This study is focused on the evaluation of corrosion resistance of plasma nitrided AISI 1045 and AISI 4340 steels. The steel samples were plasma nitrided and some of them were additionally oxidised. The corrosion resistance evaluation was performed in a fog of a neutral sodium chloride solution (NSS) according to the ISO 9227 standard. The created nitride and oxinitride layers were metallographically documented (using the light and laser confocal microscopy) and evaluated by measuring of microhardness profiles (Vickers method) under load of HV<sub>0.5</sub>. The thickness of compound surface layers of plasma nitrided and oxidized compound layers was documented by light microscopy and verified by measuring of concentration profiles by the GDOES.

**Keywords:** Plasma nitriding, corrosion resistance, structural steel

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## Influence of Drying Process of Liquid Contaminants on Adhesive Bond Strength

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Regarding effects of environment factors on adhesive bonds belongs among key requirements influencing the adhesive bond strength. The aim of experiments was to set an influence of liquid contaminants on changes of the adhesive bond strength and to set whether a degradation process is an irreversible change that means whether degradation adhesives will restore their strength characteristics depending on the time. The adhesive bonds were placed into three liquid contaminants for the time 1, 2 and 3 months. The testing process was performed after removing specimens from the liquid contaminant (marked as 0), then after 24, 72 and 163 h. A considerable fall of the adhesive bond strength has already occurred in the first phase of the testing that means after 1 month of the contamination. The rate of the adhesive bond strength fall caused by the degradation process is in the interval 10 till 92 %. This undesirable process can be subsequently suppressed by a drying process of the liquid contaminant. The experiment results certified in most cases a positive influence of the drying process of the liquid contaminants on the adhesive bond strength.

**Keywords:** Adhesive bond, degradation, exposing, two-component epoxy, testing

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## Role of Reactive Sintering in Production of Technically Important Intermetallics

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**Intermetallics offer many interesting properties, such as excellent resistance against high-temperature oxidation and creep, special magnetic properties, shape memory or the ability of reversible hydrogen storage. For these reasons, intermetallics are considered as very promising materials for many modern applications in power generation, automotive or aerospace industry and also in the medicine. The factors limiting their wider use are low room-temperature toughness and problems with their production. In this work, the possibilities of the use of powder metallurgy using reactive sintering for the production of intermetallics for medicine (Ni-Ti alloys) and for high-temperature applications (aluminides, silicides) are presented. The effect of process parameters on the proceeding reactions and structure of obtained materials is discussed.**

**Keywords:** powder metallurgy, reactive sintering, intermetallics

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## Influence of the Shock Absorbers Type Change at Stress of the Trolleybus Chassis

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ŠKODA VÝZKUM cooperated on the development of the NEOPLAN DMA low-floor articulated trolleybus intended for the Boston city (the United States). Multibody models and finite element models of the trolleybus were utilized in the stage of the vehicle design. The multibody models of the trolleybus were created in the alaska simulation tool and the simulations were especially aimed at determining forces acting in the trolleybus suspension elements and radius rods. At the end of the stage of computer modelling and testing the trolleybus prototype a decision to change the type of shock absorbers used in the axles' suspension was made. The impact of this change on forces acting in the trolleybus suspension elements (i.e. in air springs and shock absorbers) and radius rods on the trolleybus chassis when running on an uneven test track was investigated using multibody simulations. Time histories of the forces calculated utilising multibody models were used as input data of the trolleybus finite element models. Stress in the critical places of the trolleybus body structure was determined utilizing the finite element models.

**Keywords:** Trolleybus, Shock absorber, Multibody model, Dynamics, Constructional design

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## Analysis of Arc Stability in MIG Brazing of 304L Stainless Steel Using Solid and Flux-Cored Wire

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**At the present time, consumables assortment intended for utilization of MIG brazing process enables its application possibilities also for the joining of high-alloyed austenitic steels. In that case, the substitution of arc welding processes (such as MIG/MAG, or TIG) by the brazing process makes it possible to limit the weldability issue related to the crystallization of weld metal (hot cracking) and to the deformations (induced by excessive amount of heat input to the joint). Additional technological benefits may be offered by an application of flux-cored wires, which have been utilizing successfully within arc welding processes.**

**Submitted paper is aimed to verify differences in the character and behaviour of arc metal transfer and in the stability of arc during MIG brazing of austenitic stainless steel by selected types of solid and flux-cored wire electrodes.**

**Keywords:** Arc-Brazing, Brazing of 304L, Flux-Cored wire, Arc Stability

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## An Analysis of the Influence of the Titanium Compressor Wheel on the Dynamical Properties of the Particular Turbocharger Rotor

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The trend towards using turbochargers in various engines continues. In some applications, including engines of light duty trucks, city buses and even tractors and harvesters, the warranty of long life is demanded because turbochargers are subject to high cyclic loading and on consequence the turbochargers can determine the lifetime of the whole engine. The replacement of the aluminium compressor wheel for a titanium one significantly improves the turbocharger lifetime, but since a titanium alloy has about 60 % higher density than an aluminium alloy, the mass and the moments of inertia of the wheel increases, which further leads to changes in natural frequencies, rotor stability and power losses in bearings assuming the same bearing system as for the rotor with the aluminium wheel is employed. In this article the influence of the increased mass properties are discussed. AVL EXCITE and in-house developed model are used for the construction of Campbell diagrams and stability maps and for the obtaining of detailed information about the behaviour of the oil films in floating bearings.

**Keywords:** Turbocharger, Compressor Wheel, Campbell Diagram, Floating Bearings, Power Loss

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## Analysis of the Influence of Initiating Inclusions on Fatigue Life of Plasma Nitrided Steels

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The analysis of non-metallic initiating inclusions in fatigue live field is studied. The testing material for experiments is CSN 41 5340 steel (corresponds to 41CrAlMo7-10 or 1.8509). This steel is suitable for plasma nitriding process. The samples were heat treated and subsequently plasma nitrided, then subjected to the fatigue bending rotation tests. According to the principle of the tests are the conditions set to constant speed and decreased load to  $10^7$  cycles if does not the fatigue fracture of the sample happens. The thickness of the diffusional nitride layer has been won using the microhardness measuring from the surface to the core of the samples. Using the fractographic analysis the nucleation point of fatigue crack has been evaluated. In the case of initiating inclusions the size and the chemical composition was measured. Comparing the won data to the plasma nitriding proces new results have been obtained.

**Keywords:** Fatigue live, inclusion, plasma nitriding

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## Unconventional Method of Preparation Intermetallic Phases Fe-Al by Mechanical Alloying in Comparison to Reactive Sintering

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**Intermetallic phases Fe-Al appears to be a suitable material for industrial use at high temperatures. Due to their characteristic properties, such as high melting point, low toughness at room temperatures and inconvenient casting properties, it is required to explore the other possibilities for their production, especially the technology of powder metallurgy. Recently, the possibility of the preparation of these materials from powder iron and aluminium by reactive sintering technology was studied. Another way of preparation seems to be mechanical alloying and subsequent compaction by SPS. The aim of this study was to describe the mechanism of Fe-Al intermetallic phases during mechanical alloying and optimization of the process parameters. The results of this research were compared with the results of the previous description of the reactive sintering in this system.**

**Keywords:** Fe-Al intermetallic phases, mechanical alloying, spark plasma sintering

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## The Influence of Shift on Machined Surface Microgeometry and Its Use

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**Beside cutting speed, shift is another important parameter of machining. Its considerable influence is shown mainly in the workpiece machined surface microgeometry. In practice, mainly its combination with the radius of cutting tool tip rounding is used. Options to further increase machining productivity and machined surface quality are hidden in this approach. The paper presents variations of the design of productive cutting tools for lathe work and milling on the base of the use of the laws of the relationship among the highest reached unevenness of machined surface, tool tip radius and shift.**

**Keywords:** machining, cutting speed, surface roughness

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