	I3E ***South East Europe TCP***

Best Practice Report

Good Practice IMS-BAS embedded systems

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Everybody please state revision index and short description of what has been done + partners involved and date.

Final approval	Name	Partner
Reviewer		

1. Best Practice Title

Innovative technology solutions for the formation of high quality castings using the gas counter pressure and the low pressure die casting methods in the IMS-BAS.

2. Location of Best Practice

Country, region, town

Bulgaria, Sofia, Sofia

3. Best Practice Executive Summary

Describe briefly (max 10 lines) the GP context (partnership, funding, objectives, approach followed, results)

IMS-BAS offers integrated technological complex to create high-quality castings of nonferrous alloys casting method with gas pressure (CPCM).
Management processes are implemented based on microcontrollers. The development is the result of collaboration of Foundry Institute, Aachen Germany, MAGMA GmbH and Foundry Institute, Krakow, Poland, IMS-BAS. Financing of the project is under the program "Copernicus", entitled "Use of numerical simulation to obtain high quality castings from casting a gaseous pressure" (under contract CIPA-CT94-0156).
As a result the customer receives a machine, equipment and technology to ensure high quality products at high productivity, reduced energy consumption and metal and compliance with modern environmental standards.

4. Best Practice Classification

Best Practice Theme

✓ *Research Transformed to Innovative Product*
✓ *Research Transformed to Innovative Service*
✓ *Research Transformed to Innovative Methodology*
□ *Research Transformed to Innovative Production Process*
□ *Financial Mechanism for Transformation of Research to Innovation*
□ *Support Mechanism for Transformation of Research to Innovation*
□ *Other (describe)*

Best Practice Research / Application Areas

□ *Industrial / Manufacturing Systems*
- □ *Industrial Informatics and Communications*
  - ✓ *Intelligent Devices*
  - ✓ *Distributed Control Systems*
  - ✓ *Flexible Manufacturing Systems*

✓ *Embedded Systems*
- ✓ *Industrial Embedded Systems*
- □ *Nomadic Environments*
- □ *Private Spaces*
- □ *Public Infrastructures*

5. Description of Best Practice

5.1 Best Practice Context

Overall background of the Best Practice. Location, socio-economic, technical & policy background of the BP (max 10 lines)

The gas counter-pressure casting method developed by Acad. A. Balevski and Corr. Member Iv. Dimov is an unprecedented Bulgarian innovation in the development of the engineering sciences. Operating the pressure on the liquid metal and the casting being formed, the method provides new opportunities for precise regulation of the processes, connected with the volume and surface building of the castings. The complex approach for producing castings of high quality covers:

- prediction of the product quality and process parameters by modeling;
- alloy and melt quality control;
- smooth filling of the mold cavity;
- fast cooling for achieving fine grain structure;
- controllable directional crystallization;
- elimination of non-metal inclusions and porosity;
- control of the whole process, reproducibility of process parameters and product quality.

The main potential industrial partners are producers of parts for automobile-building with high requirements for strength and plasticity, corrosion resistance, reduced mass, stability and reproducibility of the production and exploitation characteristics at reduced expenses.

5.1.1 Policy Elements

What are the policy initiatives that have influenced the contextual environment of BP: innovation promotion policies, research funding policies, certification etc. as well as relevant tools (max 10 lines)

At different stages of the project implementation the cross boarder coordination was used including international institute cooperation. By past 30 years the entirely new methodology for counterpressure casting method. The last implementation introduces a large premanufacturing options for entire casting process simulation and control during real casting.

5.1.2 Socio-economic & Other factors

Other contextual factors such as customer / target market addressed, international validity, customer density, economic conditions, customer values, research area addressed (max 10 lines)

Since its first realization up to now the method is being in continuous development. The developed

technologies and machines for casting of different aluminum alloys parts were realized in more than 25 countries all over the world. A research-technical cooperation with Foundry Institutes in Aahen-Germany, Ningbo-China, Krakow-Poland, Kiev-Ukraine, as well as with leading companies in the field of casting such as "Alcoa"-USA, "American Eagle Wheel Corporation"-USA, "Intermet"-USA, DUBAL Aluminum-UAE, "Alukom"-Bulgaria and others was established. In 1975 the fist technology process was made abroad, at 2009 more than 760 factories all over the world use this technology process and these countries are: Germany, France, Italy, Poland, Austria, Hungarian, Rumanian, Russian, India, China, Canada and USA. The list of clients is enclosed below:

5.2 Objectives

Aim of the project, specific objectives & strategies to achieve these objectives (max 10 lines)

The main aim of project was to create computer based industrial automation system to control the process of casting of different aluminum alloys parts. The conventional way of manufacturing these parts do not include computerized design for the entire casting process. New approach was created to make more reliable production and to achieve small waste of the end production. In such a way new computer based simulation approach needs to provide information regarding how particular manufacturing part will be formed and cold down after this. This is a very important part of design of new metal casting machine, and it saves a lot of money and time providing a new modern approach for computer controlled design and entire process simulation before real manufacturing process.

6. Process

Describe the project including key concepts and the overall approach followed. Indicate project end users, target market, main project phases, problems encountered and solutions, problem resolution (max 10 lines)

The particular technology is being developed under the basic technology and the market requirements.

6.1 Project Design

Project design based on targeted market complete understanding, project structure, policies and procedures, management and implementation actions (max 10 lines)

The structure of the project include:
- Engineering team;
- Management department;
- Quality control department;
- Marketing department;
- Implementation department,
- Team for CAD-CAM Design, for simulation of the process of casting formation and for the optimization of the process of casting formation and casting quality.

6.2 Project Management

Activities relevant to project coordination and management, project documentation and reporting, quality control, validation and verification (max 10 lines)

The method ensures high output of 85-90%, and for large number of castings even over 90%.


BUREAU VERITAS Certification

Certification

Awarded to

INSTITUTE OF METAL SCIENCE
"Acad. A. Balevski"
67, Shipchensky prohod Blvd., 1574 Sofia, Bulgaria

Bureau Veritas Certification certify that the Management System of the above organisation has been audited and found to be in accordance with the requirements of the management system standards detailed below

Standards

ISO 9001:2000

Scope of supply

Research, development, applied sciences and production in the field of metal processing for civil and defense industry.

Original Approval Date

25 July 2001

Subject to the continued satisfactory operation of the organisation's Management System, this certificate is valid as follows:

Issue date: 23 March 2007 Expire date: 13 January 2010

To check this certificate validity please contact the managing office. Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by contacting the organisation.

Certificate Number: 212230

Kalin Panev, Director Bureau Veritas Certification Managing Office
31, Maria Louisa Blvd. 1301 Sofia, Bulgaria

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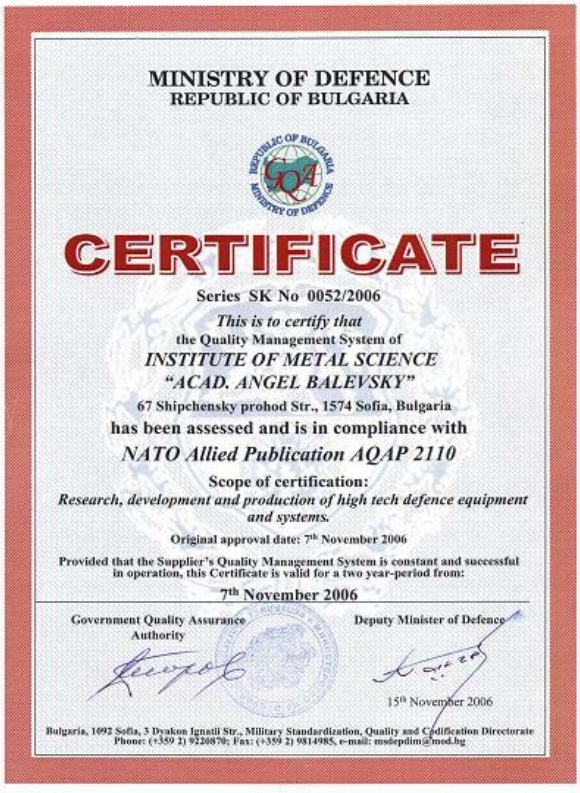
MINISTRY OF DEFENCE
REPUBLIC OF BULGARIA

CERTIFICATE

Series SK No 0052/2006

This is to certify that
the Quality Management System of
INSTITUTE OF METAL SCIENCE
"ACAD. ANGEL BALEVSKY"
67 Shipchensky prohod Str., 1574 Sofia, Bulgaria
has been assessed and is in compliance with
NATO Allied Publication AQAP 2110

Scope of certification:
Research, development and production of high tech defence equipment and systems.

Original approval date: 7th November 2006

Provided that the Supplier's Quality Management System is constant and successful in operation, this Certificate is valid for a two year-period from:

7th November 2006

Government Quality Assurance Authority

Deputy Minister of Defence

15th November 2006

Bulgaria, 1092 Sofia, 3 Dyakon Ignatii Str., Military Standardization, Quality and Codification Directorate
Phone: (+359 2) 9220870; Fax: (+359 2) 9814985, e-mail: msdepdim@mod.bg

6.3 Project Implementation

Main elements associated with the project implementation. Realization of new idea, or new technological realization or improvement / novelty to known technology and means to achieve this. Innovation associated with the project realization in terms of new products, services, methodologies. Marketing, advertising and customer service. (max 10 lines)

- The theoretical and technological fundamentals of gas counter-pressure casting of aluminum alloys are developed further and summarized. There are created mathematical models, describing the influence of main technological factors upon the structural homogeneity and the mechanical properties in counter-pressure casting of aluminum alloys.
- The influence of characteristic inhomogeneities in produced by different methods aluminum alloys castings on the structure, mechanical and fatigue characteristics is established. An analysis of the reason for their appearance is made. Solutions are suggested for their maximum reduction or removal.
- Dependences for the change of the technological and mechanical properties of Al-Si-Mg and Al-Cu-Mn-Cr-Ti alloys with the change of the components in admissible limits are established. The results can be used for précising the chemical composition, casting and heat treatment parameters to produce high quality castings.
- Dependences for the influence of harmful impurities in mixing primary and secondary AlSi7Mg alloys on the melt quality, metal loss during melting and metallurgical treatment, structure and properties of the cast material are established.

6.4 Project Evaluation

Project feedback mechanisms and evaluation mechanisms. (max 10 lines)

The gas counter pressure casting method is awarded with many prestigious prizes:

7. Description of Research team/Institution

Short description of R&D team and institution (max. 10 lines)

The R&D research team includes 10 PhD researchers and more then 100 engineers from Institute of Metal Science “Academic A. Balevski” (IMS). The research activity in particular comprises studies of the crystallization processes, structures and properties of new metal and non-metal materials, counterpressure casting of ferrous and non-ferrous metals and alloys included, plastic working and welding processes, physics, physical chemistry and heat treatment of new alloys, amorphous and microcrystalline metals and alloys, ecological technologies, machines and equipment for the production of the new materials and products thereof. The entire Institute includes about 200 scientists, 70 of whom are Doctors of Sciences.

8. Applied Financial Mechanism

Describe financial mechanisms applied in transformation of research into innovation within BP, as well as means of connecting scientific research team and financiers (max. 1000 char.)

Following the successful implementation of the project under the program "Copernicus", entitled "Use of numerical simulation to obtain high quality castings from casting a gaseous pressure" under contract CIPA-CT94-0156, together with the Foundry Institute, Aachen Germany, MAGMA GmbH and Foundry Institute, Krakow, Poland, IMS-BAS obtain distribution rights to distribute the software package MAGMAsoft in Bulgaria and also to use its great potential in the field of computer simulation of castings for scientific and commercial purposes.

9. Impact and benefits

Describe achieved benefits of R&D team and/or enterprise implemented innovation, as well as impacts on institutional and policy levels. (max. 1000 char.)

Own developments in mathematical modeling, together with those of MAGMAsoft were used in developing intelligent microprocessor control machines for casting in CPCM. For this purpose was used the rich experience gained in IMS-BAS in the development of innovative technologies replacing conventional casting such technologies and to obtain details through plastic deformation (especially large marker castings to 100 kg. complex built surface pronounced thermal units and high mechanical parameters), requiring the development of management systems MLPN. The main potential industrial partners are producers of parts for automobile-building with high requirements for strength and plasticity, corrosion resistance, reduced mass, stability and reproducibility of the production and exploitation characteristics at reduced expenses.

10. Sustainability

Provide information on sustainability of innovation after financial aid within implemented financial mechanisms, and some multiplier effects as replication and extension of the action performed in BP. Expected use of Best Practice and lifecycle considerations. (max. 1000 char.)

Machines and technologies developed in the Institute are in operation in different countries in the world, namely Germany, France, China, Japan, India, the ONDP, Poland, Venezuela, the USA, etc. More than 15 companies in the USA and Canada are using the JET-MAG magneto-hydrodynamic machines for soldering the commutators of the automobile starters designed for FORD, CRYSLER, GENERAL MOTORS, etc.

11. Repeatability and transferability

Lessons learned from the project implementation team. Repeatability and transferability of the project. (max. 1000 char.)
Technology and specialized molding machines have been developed very actively in recent years. To date reference list indicates the presence of more than 660 machines working in over 25 countries worldwide. The application of the method is extremely successful in the production of aluminum parts of critical function for automobile-building, aircraft building, electronics, hydraulics and pneumatics as well as for replacement of parts, produced by forging, stamping or welding. Only by the method of gas counter-pressure casting of aluminum alloys it is possible to produce large-size parts of complex combination of thick and thin walls, subjected to high dynamic and cycle loading. The method ensures **high output of 85-90%,** and for **large number of castings even over 90%.**

Customers that have introduced the technology process since 1975 – 2010.

12. Evaluation

Describe reasons and evaluation criteria why the described example is a best practice. (max. 1000 char.)

This good practice shows how scientific engineering inventions made in the Bulgarian Academy of Sciences in the seventies was converted into a standard industrial process management and control of production of metal counter. Since the first introduction to the methodology is now developed and supplemented by the latest developments allow full computer design the desired products, simulation of manufacturing processes to achieve high quality output. Full computerization and automation, combined with high quality finished products ensure that this production method is unique that it has become the preferred manufacturing method used m many leading global companies. Over the years the technology was further developed, and funding has been internally - from sales in, and also through participation in international and national scientific projects. The latest in technology is the ability to entirely computer-based simulation of the manufacturing process, quality assurance and cost when introducing new technology for new generation of highly responsible mechanical parts used in automotive, aviation and engineering.