

EPMA European Structural Parts Group

**High Temperature Sintering - analysis of commercially available alloys
(processes and properties) “HTS” Club Project**

Consortium Agreement

Issued March 2017

The Project – ‘HTS’ as defined in Annex 1

The Contractors – Powder Metallurgy Solutions, Dr. Volker Arnhold, Kottsiepen, 62, 42369 Wuppertal, Germany: **IC**
Powder Metallurgy Consulting, Dr. Vladislav Kruzhanov, Am Hardtpark 9, 42897 Remscheid, Germany: **IC**
Department of Industrial Engineering, University of Trento, via Sommarive 9, 38123 Trento, Italy : **UNITN**

The Coordinator – The European Powder Metallurgy Association, Talbot House, 2nd Floor, Market St., Shrewsbury SY1 1LG, England: **EPMA**

The Members – Paid corporate EPMA members funding the Project

The Participants – Paid corporate EPMA Contractors and the Members

The Coordinator and each of the Participants are individually referred to as a ‘**Party**’ and jointly as the ‘**Parties**’.

UV = unanimous vote of Members and Contractors.

Heads

1. The Members and Contractors agree to cooperate in order to complete the Project according to Annex 1.
2. The Parties undertake for the duration of the Project and for a period of five years after the delivery of the final written report to the Members, to hold in confidence all confidential information (as defined below) disclosed by either Party to the other and to refrain from disclosing confidential information to any third party. Confidential information shall only be disclosed when necessary for the performance of the Project and subject to UV.

Confidential information shall include all technical, financial and business information regarding the Parties and their subsidiaries, as well as their products, processes, production methods and techniques (including metal powder samples), provided that confidential information shall not include:

- (i) information which was known by the receiving Party at the time of disclosure as shown by written record to this effect;

- (ii) information which at the time of disclosure is in the public domain or which is published after disclosure or otherwise becomes part of the public domain through no fault of the receiving Party;
 - (iii) information which the receiving Party can show was received by it from a third party who did not, to the best knowledge of the receiving Party, acquire the information, directly or indirectly, from the other Party under an obligation of confidence
3. The Contractors agree to refrain from carrying out similar projects on high temperature sintering of commercially available alloys with organisations other than the Members until completion of the Project (delivery of the final report).
4. The Members agree **to share equally the total Project fee** of EUR 40 000. The required minimum number of Members is **eight** unless the Members agree to exceed the **maximum Individual Project Fee of EUR 5000 per Member**.
5. New paying members may be admitted during the Project by UV on payment of an additional reasonable premium (10%). The premium will be used to decrease the Project Fee for the other Consortium Members.
6. VAT: VAT will be added to the Project Fee as appropriate but may be reclaimed according to local arrangements (e.g. "Reverse Charge" mechanism). All VAT numbers are to be provided to the EPMA.
7. The Members also undertake to provide the Contractors with the necessary powder materials for the Project. If no agreement on the in-kind contribution can be made between the Participants, each Member is free to withdraw from the Project. If the Consortium agrees to subcontract the in-kind internally or externally at additional costs, the EPMA will coordinate this task and charge equally each Member to cover the cost plus an administrative fee of 15%.
8. **Payment Schedule:**
 - 50% at the start of the "HTS" Project,
 - 50% after completion of the "HTS" Project and delivery of the final report of the Part.
9. **IPR** relates to all results in the form of technical information, know-how and intellectual or industrial property rights, including but not limited to patents, models, designs, copyright, trade secrets and rights in unpatented know-how. "Foreground IPR" means any IPR arising or resulting from the Project. Foreground IPR shall be the property of the Party performing the work generating the Foreground IPR. Should several Parties have contributed to the results – then the IPR shall be the property of the Party who has predominantly contributed to such result. Each Member is granted a global, perpetual, royalty free license to freely use any and all Foreground IPR (including the right to change, alter, amend and sub-license such Foreground IPR). Background IPR means any IPR owned or controlled by a Party at the date of signature of this agreement or developed and/or acquired independently of this agreement. Background IPR shall remain the exclusive property of the Party providing such information. For the avoidance of doubt, no license rights are granted regarding Background IPR through this agreement.
10. **Warranty:** The Contractor's warranty extends solely to the use of due scientific diligence and to compliance with accepted engineering practice. The Contractor does not guarantee that the desired objectives of the research and development project will be achieved.

11. **Liability:** The Contractor is liable for negligence. The liability covers the proven damage.

All the terms of this agreement may be changed by UV, except for 2, 4, 10 & 11.

Coordination will be undertaken by the EPMA, who will have responsibility for invoicing, day to day liaison with the Contractors and keeping Members informed. The EPMA will operate under the same confidentiality agreement as Members and the EPMA President will arbitrate any unresolved disputes.

Signatures: signed individually by all Members and Contractors

ORGANISATION:

VAT NUMBER:

DATE:

SIGNATURE:

Annex 1

High Temperature Sintering - analysis of commercially available alloys (Processes and properties) “HTS Club Project”

Project description

Structure: Club Project coordinated by **EPMA** (Dr. Olivier Coube) and managed by an independent industrial consulting group (Dr. Volker Arnhold & Dr. Vladislav Kruzhanov) with the support of the Department of Industrial Engineering of the University of Trento (Prof. Alberto Molinari, Prof. Ilaria Cristofolini).

Members:

“Ideal” composition:

- 4 Powder producers: e.g. Höganäs AB, Hoeganaes Corp., Pometon, Rio Tinto-QMP, supplying 1 powder each
- 2 – 4 Parts producers, some should offer access to equipment for the sintering runs (e.g. GKN Powder Metallurgy)
- 2 – 4 Furnace producers (no direct tasks)

Background: High temperature sintering of PM steels has been talked of since decades, but it never really took off to a significant importance in industry. The arguments pro HT-Sintering have been discussed during several international conferences and ESPG meetings.

Nevertheless, there is still a slow start in the expansion of the new alloy and furnace technology, but several commercial applications exist in the market and have been published.

Objectives: There are several arguments for a new approach to push HTS again:

- Commercial availability of tailored alloys by several powder suppliers
- New furnaces designed for improved HTS are on the market
- Availability / proof of successful parts and applications (properties AND cost)
- HTS is one way to overcome some REACH challenges in a very elegant way (no/low Ni content)

An EPMA Club Project could be a driver for the technology to analyze in a common effort the best commercially available alloy system for HTS and compare several existing furnace concepts.

Benefits for industrial partners:

A Club Project is proposed to make a new effort on HTS by partnering the players along the complete supply chain. Every partner will get a solid set of information how to continue with HTS in his business.

Key steps of the project:

- Manufacturing of test parts of several commercial alloys,
- Sintering in industrial furnaces at club members and
- Testing some mechanical and dimensional properties for a quick evaluation.

Work Packages

The project is subdivided into 5 Work Packages (WP)

WP1

Kick-off meeting of the project members, definition of follow-up actions, definition of the place and time of compaction and sintering of the samples.

It is supposed to use 4 mixes of powders for the trials: A (HAB), B (HC), C (POM), D (QMP) and as a reference 1 mix Distaloy AE (HAB) → totally 5 powders per sintering run

Ready mixes including lubricant of choice of powder producer will be used.

Deliverables WP1: 5 powder grades (each 50 kg) to the company responsible for compaction of the samples

WP2

All samples to be compacted at ONE site – e.g. Höganäs POP centre, GKN Innovation Centre, tbd.

The samples, 100 test bars and 100 rings (OD 40mm, ID 30mm, H 5mm) will be compacted from every powder grade to the same density of 7.0 g/cm³ and specially packed.

Deliverables WP2: Green samples to partners for sintering.

WP3

Sintering (incl. documentation) at SEVERAL locations applying different HTS furnaces (and compare to belt furnace sintering as reference)

Each powder grade to be sintered at 1120°C belt furnace and 1250°C HT-furnace under 95N₂ + 5H₂

All sintering runs should include sinter hardening and (external) tempering (if not available a complete external heat treatment should be added)

Deliverables WP3: Sintered parts to UNITN for evaluation of properties

WP4

Analysis of properties at ONE institute (UNITN)

- Tensile strength and ductility, hardness, density, microstructures (test bars)
- Dimensional behaviour and dimensional and geometrical precision (rings)

Deliverables WP 4: Results of measurement to PM Solutions

WP5

Evaluation of experimental results and Final Report

Deliverables WP 5: Final Report confirmed by PM Solutions to EPMA and Project Members

Work Package time planning

Duration of the project is ca. 5 months: every Work Package needs ca. 1 month.

Project Management and Reporting

- Project Management VA (3 days) and VK (10 days) for full documentation and to supervise all operational steps
- EPMA Management fee of 15% is added to the costs

Project costs

A summary of the Project costs is presented in the following Table:

Powder	no. of grades	kg/grade	€/kg	Cost	Organisation
	5	50		in-kind*	Ind. Partners POWD
Compaction	no. of samples	samples/day	€/day		
	3000	1500	1340	2 680€	Ind. Partner 1**
Sintering	runs/furnace	no. of furnaces	€/run		
	1	3	1500	4 500€	Ind. Partner 2**
Analysis of samples and documentation (1 week)				12 000€	UNITN
Project management incl. travel:		man-days	€/day		Powder Metallurgy Solutions
		13	1200	15 600€	Powder Metallurgy Consulting
			Subtotal:	34 780€	
EPMA management fee (15%)				5 220€	
			Total:	40 000€	

*See Item 7 of the Consortium Agreement

**Industry Partners POWD (likely Powder Producers), Industry Partner 1 and Industry Partner 2 must be part of the HTS Consortium.