POLITECNICO DI TORINO

Allegato 1

Technical specification for the gas-atomizer devoted to the production of Metal Powders

Premises

The equipment to be purchased will be installed into the Integrated Additive Manufacturing @ POLItecnico di TOrino Center (IAM@POLITO Center). This center was conceived as a research platform to be equipped with specific and important apparatus, that will allow to develop a series of multidisciplinary research activities. The Center aims at providing answers to some open questions in the field of additive manufacturing (AM) of metallic components and, in general, of all the integrated powder metallurgy technologies (from powder generation to the post-treatment of components fabricated via the most advanced techniques of powder metallurgy).
Recently, the IAM@POLITO Center was awarded with a specific funding named INFRA-P (P.O.R. FESR 2014/20 – Asse I – Azione I.1.a.1.5 – Codice domanda 321 – 30) provided by the Piedmont Region. The reference Action addressed by the IAM@Polito project was the I.1.a.1.5 "Sostegno alle infrastrutture di ricerca considerate critiche/cruciali per i sistemi regionali" ("Funding of Research Infrastructure considered critical/crucial for the regional system"). The specific aim of this Funding Action is to provide investments in laboratories, and in their related scientific equipment, in order to develop strategic Research Infrastructures having the scope of performing research activities leading to relevant applications for the regional industrial sector. A specific request of the INFRA-P funding scheme is that the equipment purchased thanks to this funding has also to be partially used to offer external services to industries of Piedmont and other regions.

To cope with these premises, the equipment to be purchased must have the capability of satisfying needs related both to scientific studies and to small batches production.

Technical requirements of the foreseen system for the production of powder batches

Within the framework of the activities described in the premises, the research group working in the IAM@Polito has planned to acquire a gas-atomizer for the production of metal powders.

Powders created by the system will be processed in the facilities of the Center, particularly by means of the Electron Beam Melting (EBM) machine, the Laser-Powder Bed Fusion (L-PBF) machine and the Hot Isostatic Pressing (HIP) system.

The requested system will therefore be used to generate powder batches to be further processed within the IAM@Polito Center, mainly for research purposes. Nevertheless the production of small batches of powders for third parties is foreseen, in the frame of the technological transfers to the industrial and research sectors of Piedmont and of other regions.

The main research interests of the IAM@Polito Center, in terms of metal powders, are related to the following metals and/or alloys based on those metals:

Aluminum, Cobalt, Copper, Gold, Iron, Magnesium, Nickel, Silver, Zinc (in pure and alloyed form)

Moreover, the following elemental pure metals are of particular interest for the IAM@Polito Center and have to be produced by the system:

Chromium, Palladium, Platinum, Vanadium (in non-alloyed form)

The gas-atomizer to be acquired needs to be able to operate with the aforementioned metals and to guarantee the possibility to obtain, starting from them (or from alloys based on those elements), powder batches easily to be processed with the production techniques (namely EBM, L-PBF and HIP) available in the IAM@Polito Center.

Keeping in mind these needs and some specific constraints of the laboratory where the equipment will be installed, **a list of mandatory technical requirements** for the gas-atomizer to be purchased is given in the following points:

- The system has to guarantee the production of powder batches **within an integrated cycle**, which must be carried out **without any interaction** between the operator and the products in the intermediate stages of production
- Powders produced by the system have to be classified as spherical
- In case of pure elemental metals Chromium, Palladium, Platinum and Vanadium it is necessary to include extra equipment to guarantee the production of spherical particles in these elements
- The system has to produce powders with a median size (d_{50}) located in the range 10 to 180 microns and, in particular, a yield of 50% in the size range 15-53 microns without either classification or sieving
- Powders produced by the system, with the aforementioned median size (d_{50}), have to be automatically collected in a container properly designed so as to avoid any contact with the atmosphere
- The system has to be equipped with a device allowing to separate, **within the production cycle** of each powder batch, the finer particles (i.e: particles having a size lower than 10 microns) which may derive from the process.
  Such powders have to be automatically collected in a container different from that mentioned in the previous point, which must be properly designed so as to avoid any contact with the atmosphere
- The amount of powder to be produced by the system, with the (d_{50}) ranging from 10 to 180 microns, has to be included, for **each single production run**, in the range 1 to 4 kg of Aluminum (elemental or as a base element of the alloy), 3 to 12 kg of Iron (elemental or as a base element of the alloy), 3 to 12 kg of Copper and Nickel (elementals or as base elements of the respective alloys) and 3,5 to 15 kg of Silver (elemental or as a base element of the alloy)
- The processing time for the production run of each powder batch has to be shorted than 4 hours
- In order to avoid the contamination of the generated powder batches, the system has to operate, in all its parts, in vacuum (minimum value 1 mbar or below) or in overpressure, with inert gases such as nitrogen, argon of helium
- When operating in vacuum, the system has to reach the value of 1 mbar in less than 15 minutes
- When operating with inert gases, the system has to allow working also with heated-up gases (at the minimum Temperature of 500°C). This is mandatory in order to increase the kinetic energy of the gas and reduce the median size of the powders. The system must have cooling systems to accommodate the additional heat energy injected

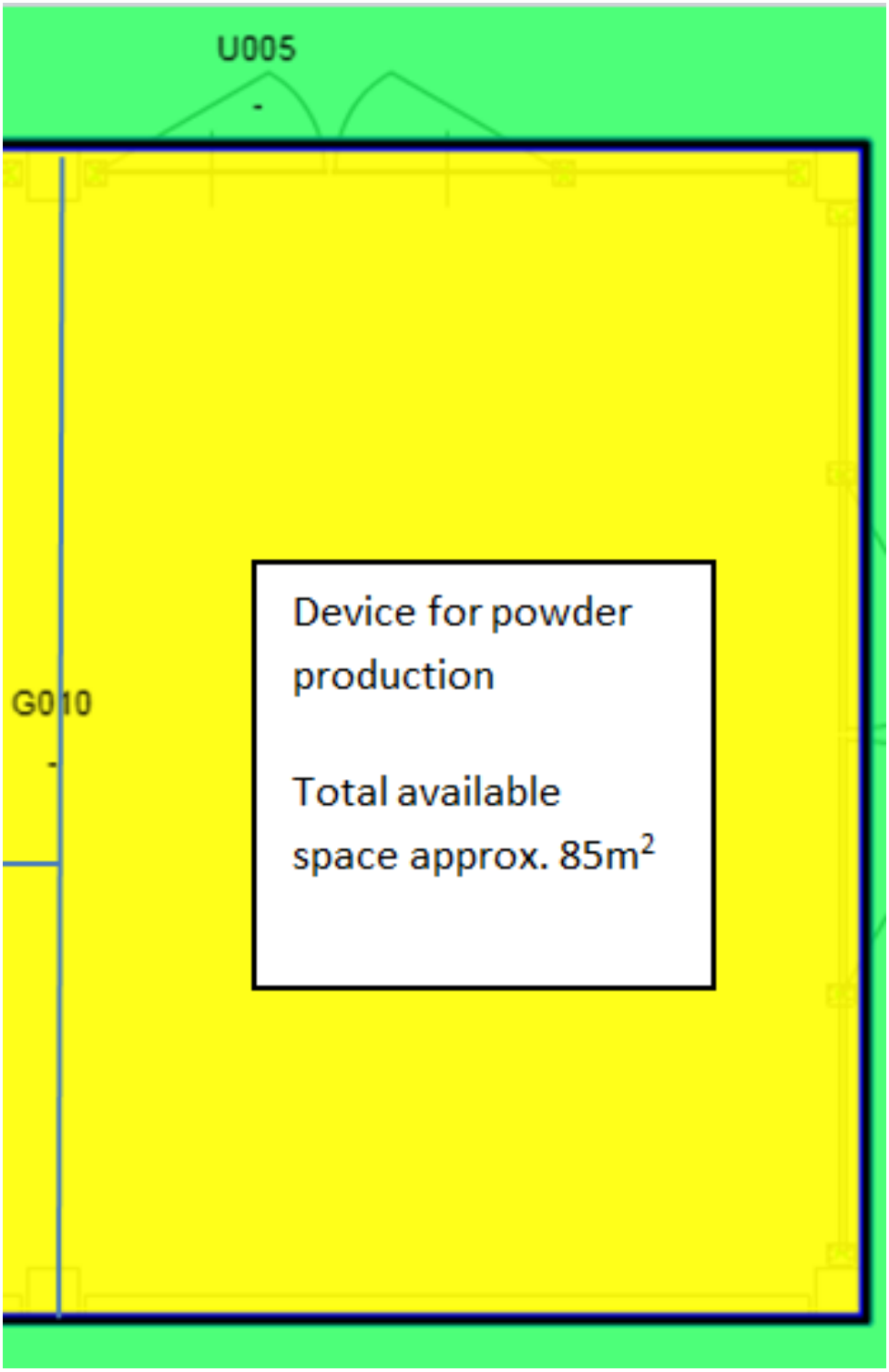
- Given the interest of the IAM@Polito research group of working with Al and Mg based products, in order to avoid any explosion or flame formation during the powder generation, the system has to be equipped with a O_2 monitoring device, with a minimum resolution of 10 ppm. The equipment supplier shall provide operating parameters and informations and tools necessary for the system usage to enable safe and effective production of powers, including the explosive ones.
- For the preparation of powder batches, it has to be possible to introduce into the system, as "raw materials", elements in the pre-alloyed form or as pure metals with master additions
- In all its sections, the system has to provide indication about the temperatures, measured by thermocouples. For safety reasons, it is also requested to have an external device (i.e: optical pyrometer,…) to measure the temperature in the hottest part of the system

- The system has to be interfaced with a Main Control Device, so to allow the operator to monitor all the different steps in the production of the powder batches. In addition, a Programmable Logic Controller (PLC) and safety systems have to be installed, in order to supervise the operator inputs, the control states and the alarm and safety interlocks, with the goal of protecting the user and the equipment. The PLC must prevent unsafe combination of commands to be programmed in the system, which could act compromising the integrity of the equipment and the operator safety
- A video system has to be present, to monitor the evolution of powder production
- The system is requested to be able to accept implementations for the injection of particulate, up to 20% in volume, in order to produce Metal Matrix Composite Particles with a maximum size of 100 microns
- In order to guarantee the correct start-up of the system the supplier has to provide a starter kit of consumables, necessary for the starting activitity of the system, carried out on-site, in order to settle the proper processing parameters
- **Safety aspects**. The entire delivered assembly has to be provided with CE certifications. These certifications have to be provided by the supplier and at its own expenses.
- The supply of a **separated sub-system for cooling the water (chiller)**, necessary to all operations to be performed during the powder production cycle, is also requested. The sizing of the chiller has to be suitable for the delivered system
- **Layout in relation to the final location**. The system will be located in a laboratory with a definite space (see attached preliminary layout of the laboratory). Therefore, it is requested that, apart from the gas supplying system (gas bottles or gas tank) provided by the Purchaser and the chiller, the system and all its eventual auxiliary equipment are assembled in an area which has to be (in plan view) smaller than 6m x 6m. The total height of the system has to be smaller than 6m
  At the same time, the assembly of the system and of all sub-systems has to guarantee easy access for the operator to all working areas during service operation as well as during standard maintenance
- The system has to be transported from the supplier site to Politecnico di Torino, Alessandria Campus, Viale Teresa Michel 5, Alessandria (Italy). The **unloading at floor level** and the performing of mounting, **installation and final testing** of the equipment are requested on-site
- **Delivery time**. Starting from the date of the order, the equipment will have to be delivered, installed and tested for functionality at Politecnico di Torino, Alessandria Campus, within 7 months
- The **system** managing parameters have to be **open.** The supplier is requested to delivery of a set of parameters for the production of different powder batches. However**,** in order to allow the

modification of the powder production cycles, as function of the base element used, it has to be possible to edit into the system new parameters

The IAM@Polito Center therefore aims at producing new powder systems, developing and implementing the powder production process

- The system has to be new and not refurbished
- The system has to come with at least 1 year of warranty provided by the producer


U005
G010
Device for powder production
Total available space approx. 85m²