

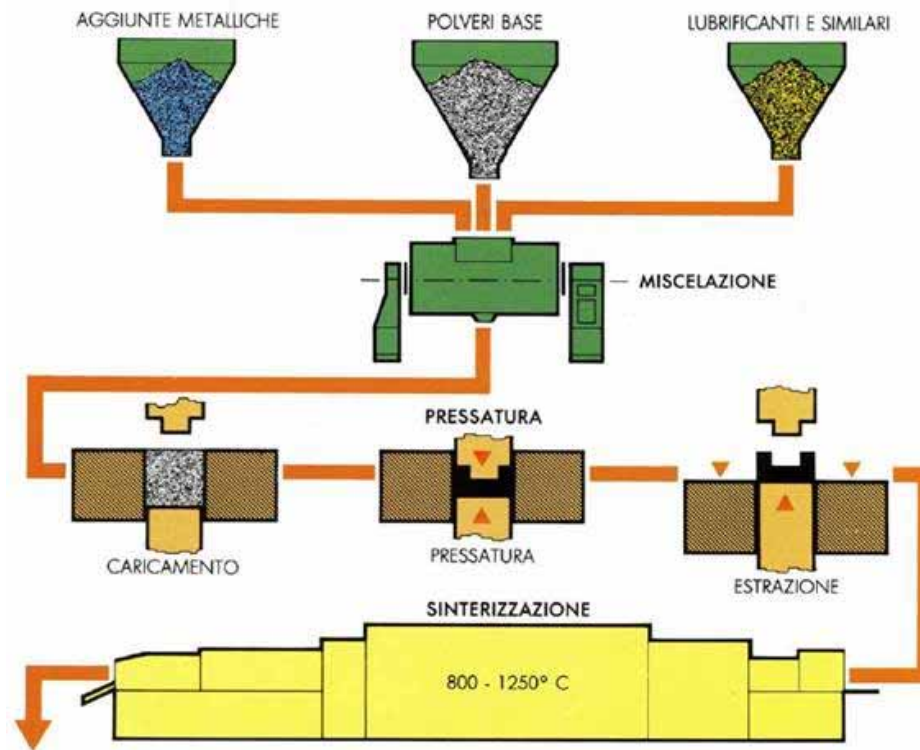
# Importanza delle polveri metalliche nella produzione di componenti aerospaziali

**Marco Paura**  
CEO NUMANOVA S.p.A.

**WORKSHOP on ADDITIVE MANUFACTURING IN APPLICAZIONI AEROSPAZIALI**  
**TERNI, 13 GENNAIO 2020**

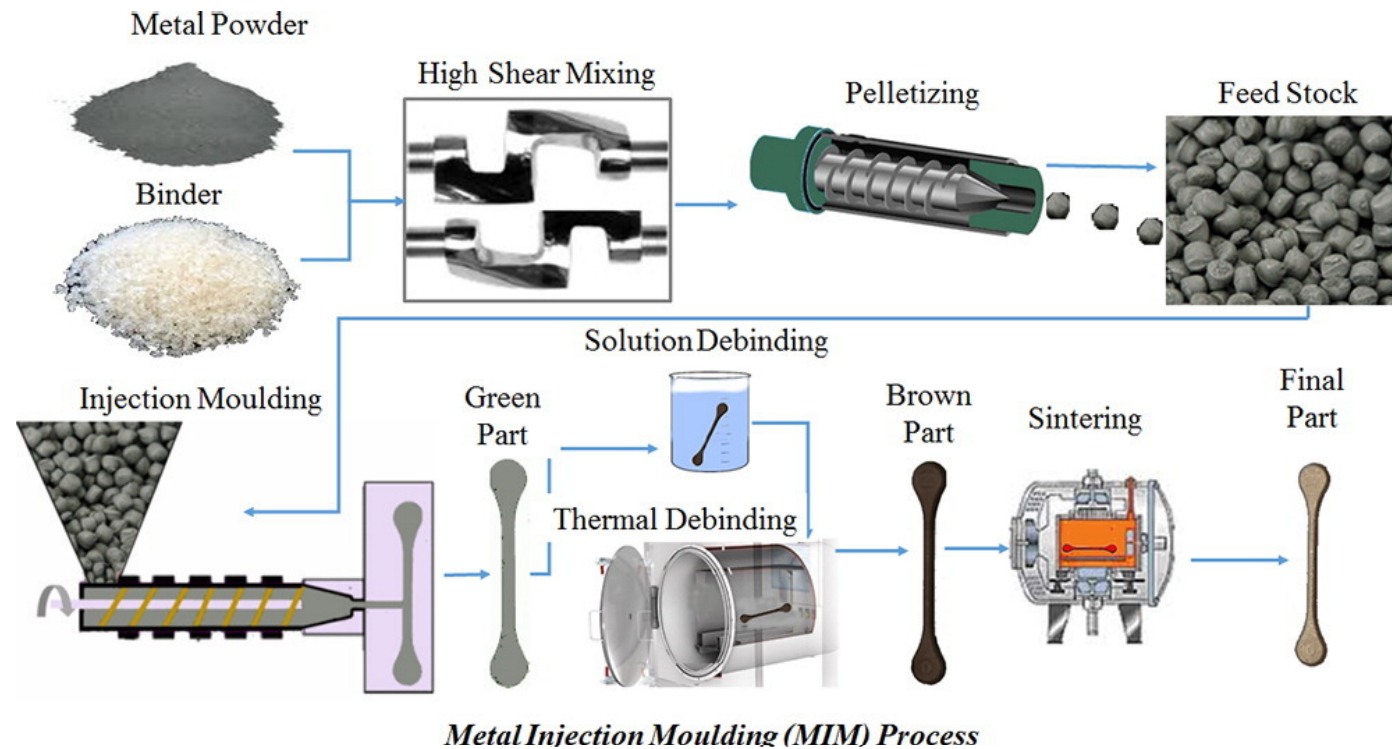
# POWDER METALLURGY...AN OLD STORY

Powder Metallurgy is not a new issue...Sintering processes as well as Cladding, Surface Coating, Shot Peening and so on are all metallic powder applications which, in certain cases are older than fifty years.



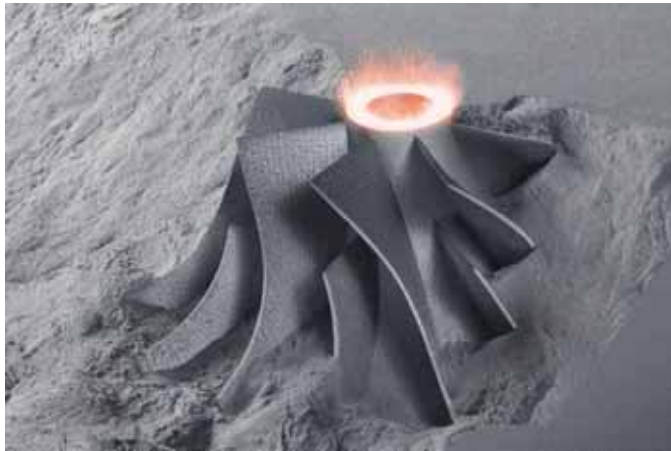
# POWDER METALLURGY...NEW FRONTIERS

Since last 30 years, many new applications for metallic powders have been developed: Metal Injection Molding (MIM), Hot Isostatic Pressing (HIP), 3D Printing ecc...

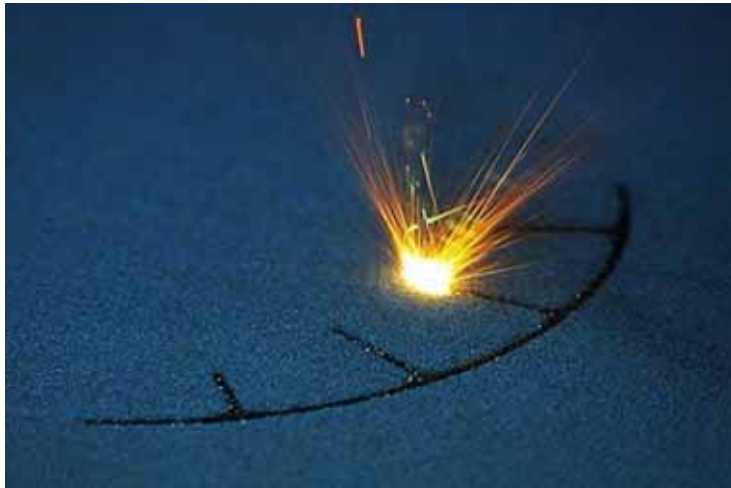




# POWDER METALLURGY...NEW FRONTIERS



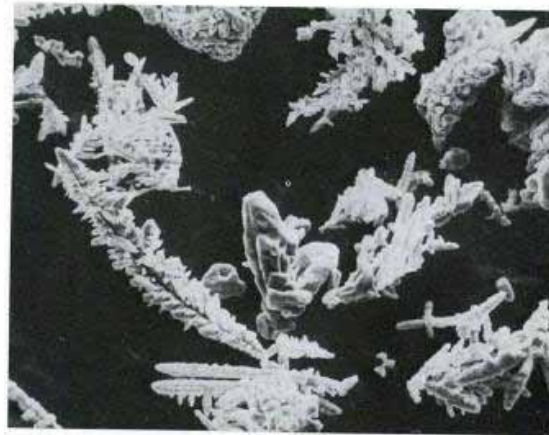
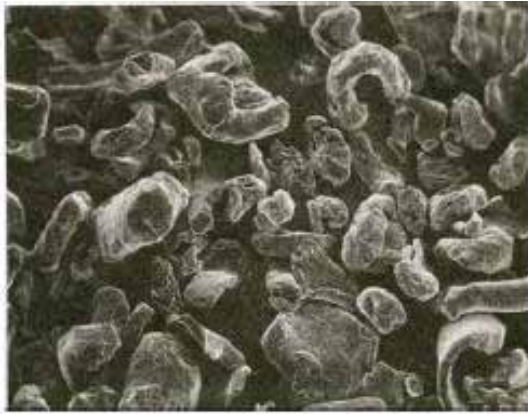
Single Laser Selective  
Melting Printing



Multiple Laser Selective  
Melting Printing

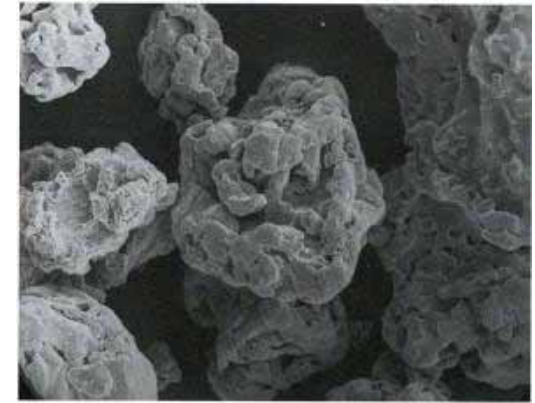


# OLD AND NEW POWDERS....



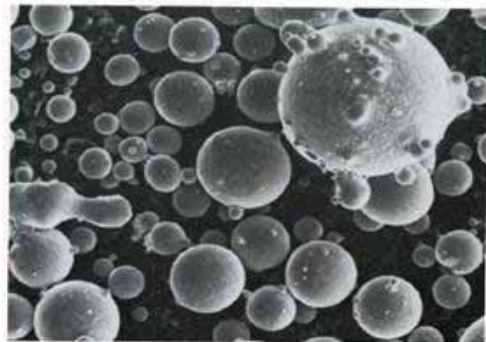
Cu

SEM, 1400x



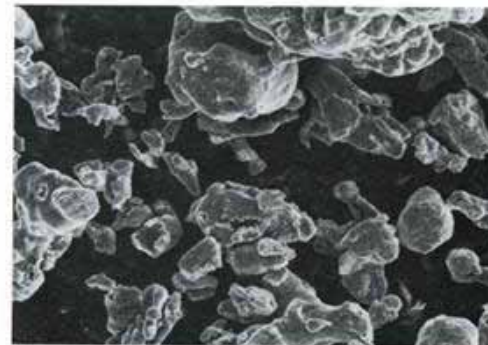
Fe

SEM, 300x



High speed steel

SEM, 300x

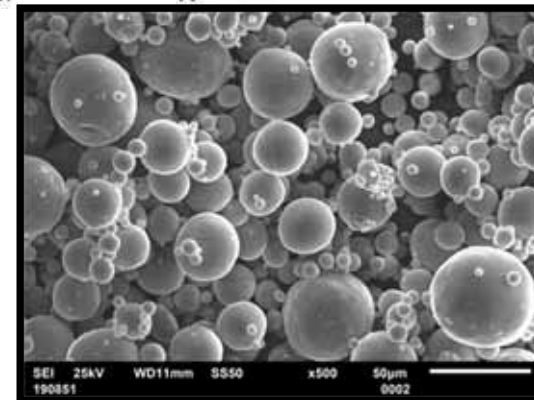


High speed steel

SEM, 300x

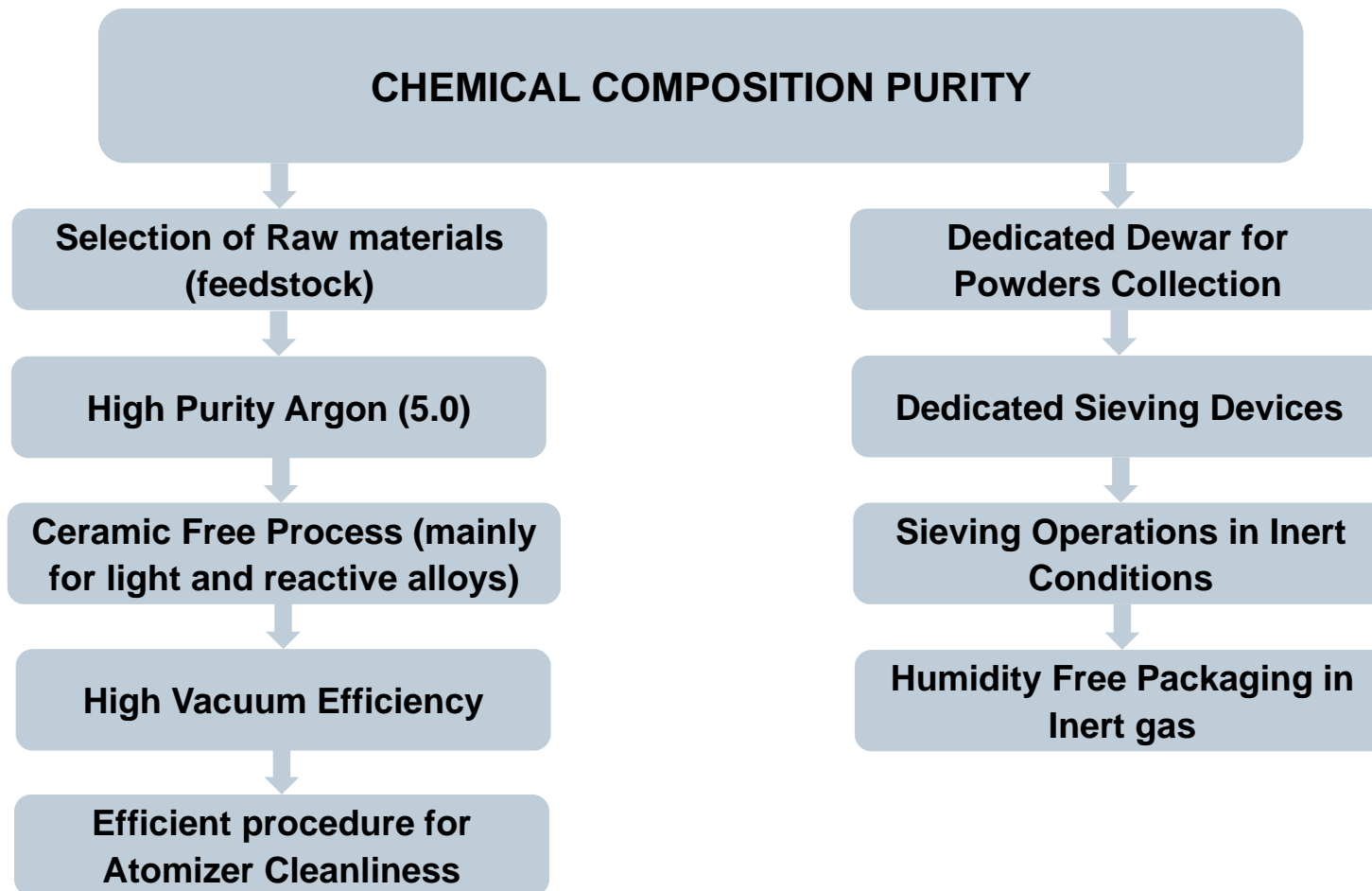
**Inert Gas Atomized HSS**

**Water Atomized HSS**

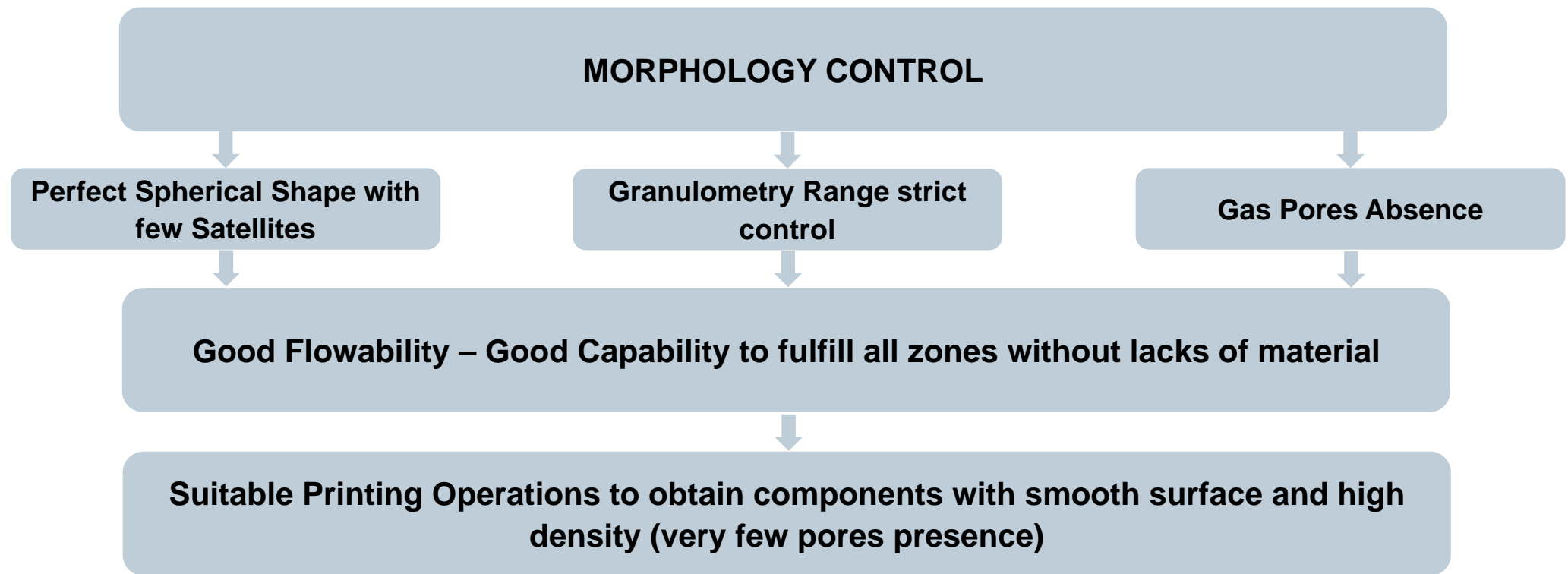


**Inert Gas Atomized Cu\_OFE**

# METALLIC POWDERS CHARACTERISTICS FOR AM AEROSPACE COMPONENTS PRODUCTION

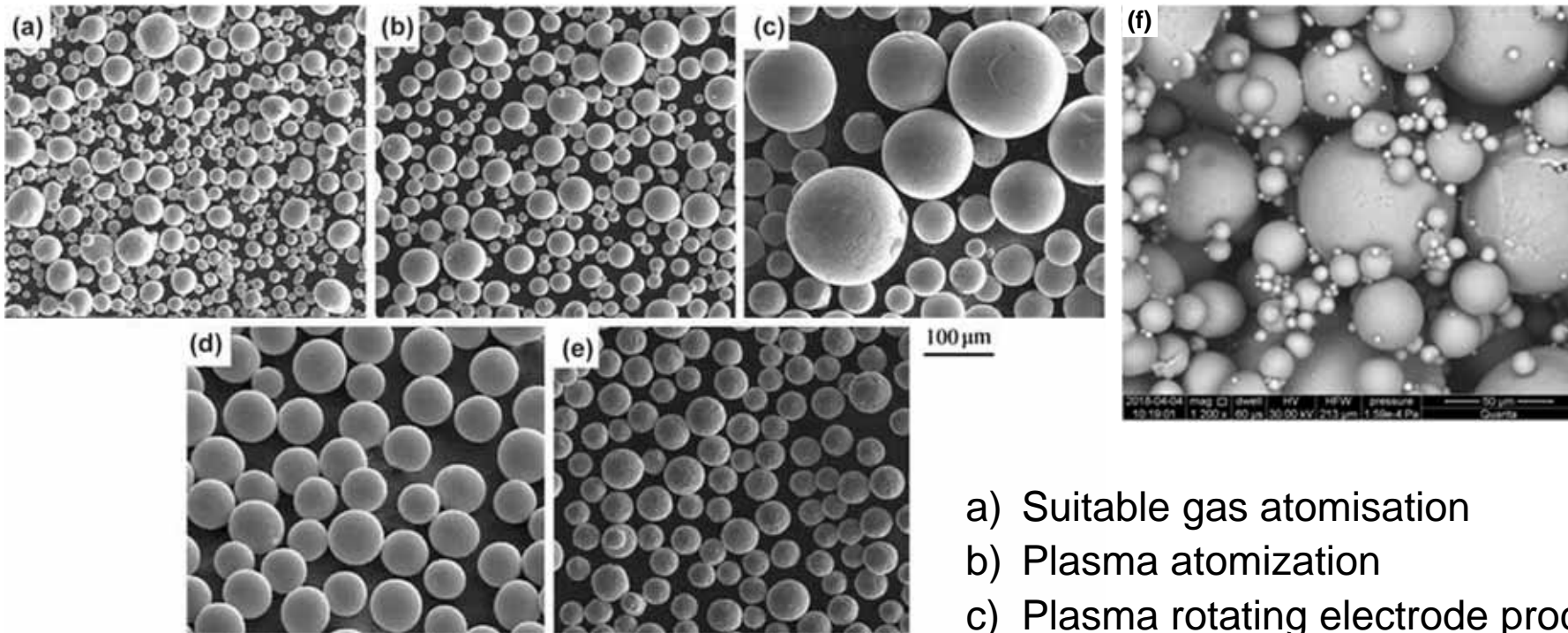


# METALLIC POWDERS CHARACTERISTICS FOR AM AEROSPACE COMPONENTS PRODUCTION





# WHAT ARE SATELLITES....

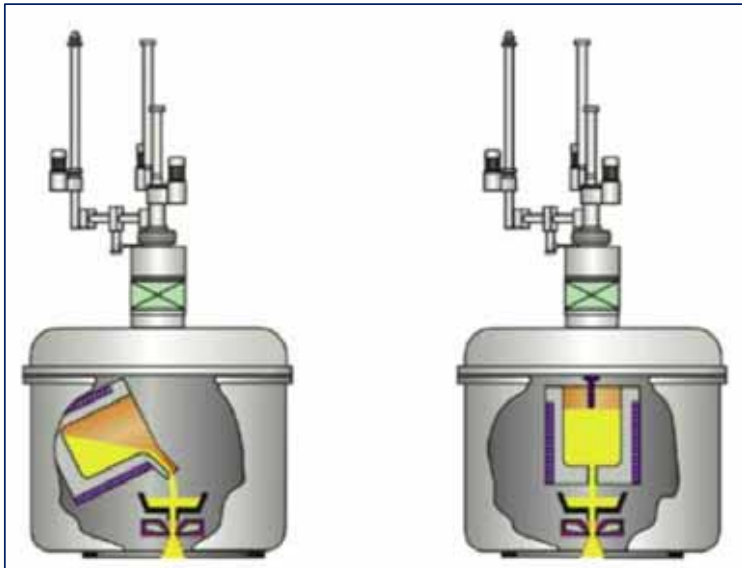


- a) Suitable gas atomisation
- b) Plasma atomization
- c) Plasma rotating electrode process
- d) Plasma spheroidization
- e) Granulation-Sintering-Deoxygenation
- f) Not suitable gas atomization



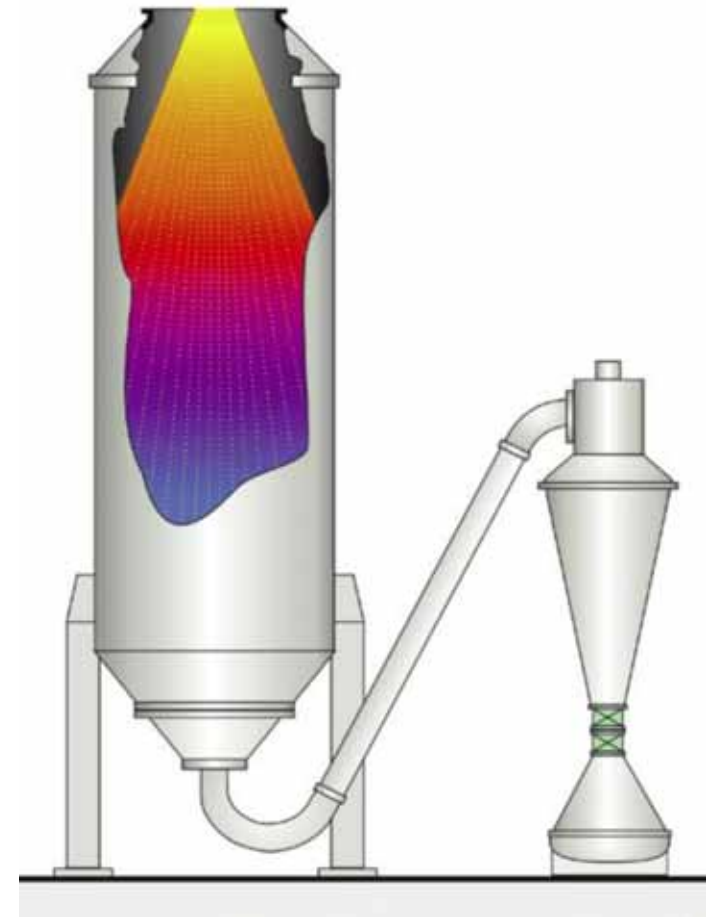
# VACUUM INERT GAS ATOMIZATION: VIGA

## MELTING UNIT



Used for the production of non reactive alloys, such as stainless steels, nichel alloys, cobalt alloys. With some additional safety and structural devices it can be used even for aluminium alloys powder production. More difficult is the production of Titanium alloys powders.

## ATOMIZING UNIT

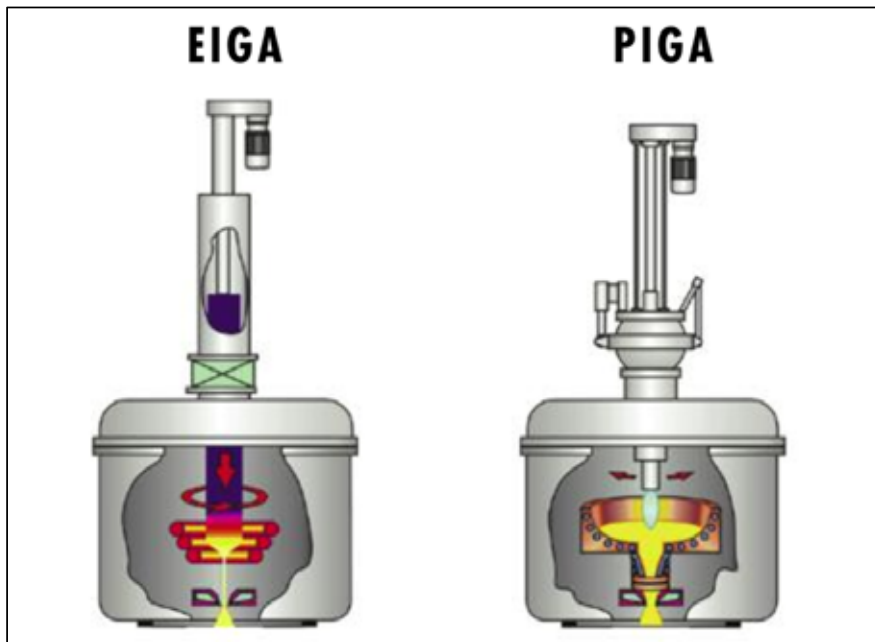


# CERAMIC FREE POWDERS PRODUCTION

**EIGA: Electrode Induction Melting Gas Atomization**

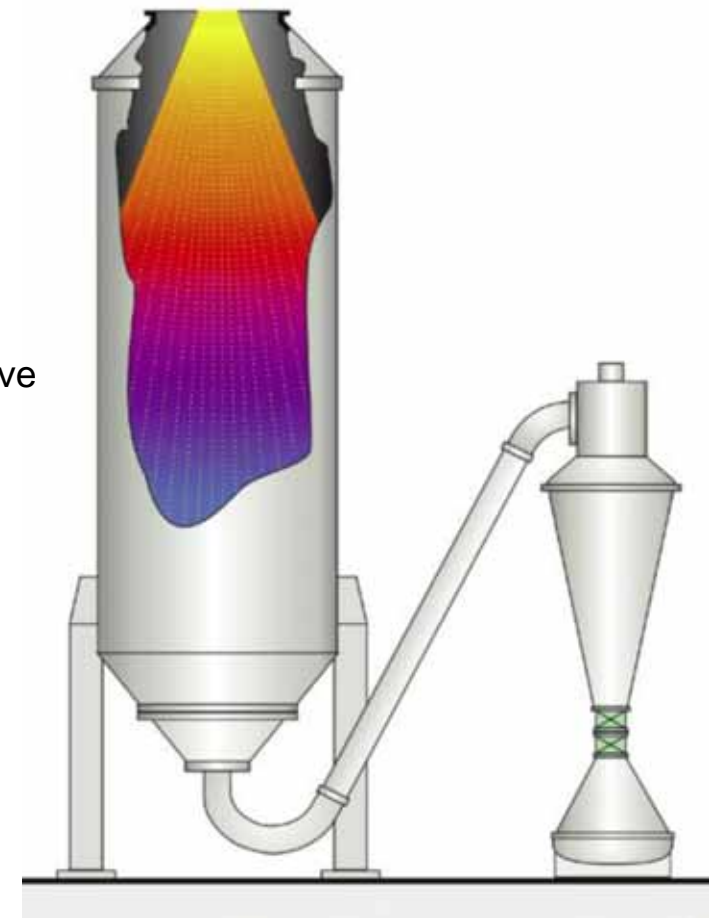
**PIGA: Plasma Melting Induction Guiding Gas Atomization**

## MELTING UNIT

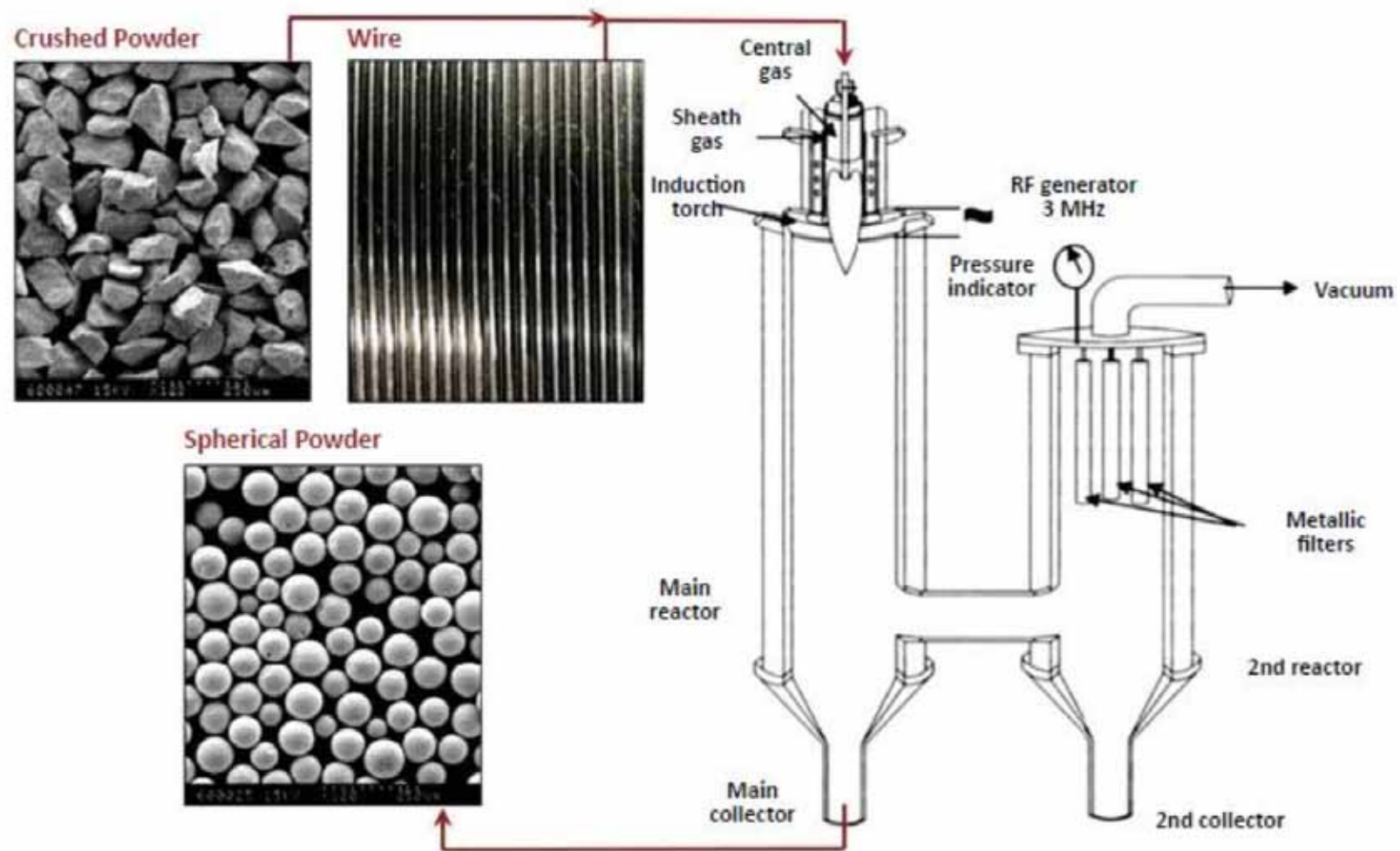


Used for the production of  
ceramic free powders, reactive  
and/or high melting alloys

## ATOMIZING UNIT



# PLASMA ATOMIZATION

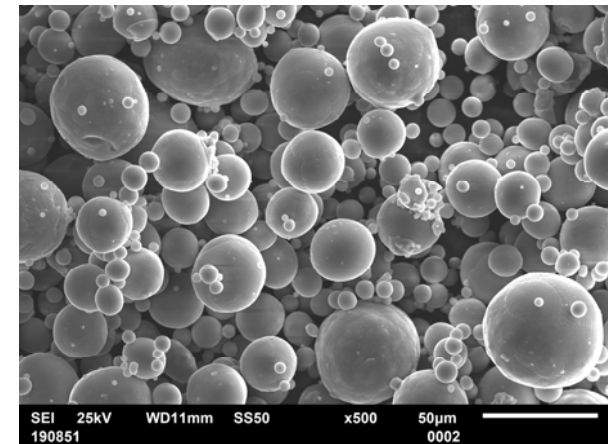


# ATOMIZATION TECHNOLOGIES COMPARISON

TECHNOLOGY	ADVANTAGES	DISADVANTAGES
VIGA	HIGH PRODUCTIVITY	NOT SUITABLE FOR LIGHT REACTIVE ALLOYS
	GOOD YIELD FOR SMALLER SIZES	
	GOOD SPHERICAL SHAPE OF POWDERS	HIGH ENERGY CONSUMPTION
	LOW PRODUCTION COST USING NITROGEN AS ATOMIZING GAS	POSSIBLE CONTAMINATION FROM REACTION BETWEEN LIQUID METAL AND REFRACTORY CRUCIBLE
	CUSTOMIZATION OF CHEMISTRY	
EIGA	HIGH POWDER PURITY	HIGH GAS CONSUMPTION
	REACTIVE ALLOYS PRODUCTION	HIGH PRODUCTION COST
	PRODUCTION OF SMALL LOTS OF POWDER	LOW YIELD FOR SMALLER SIZES
	LOW ENERGY CONSUMPTION	SATELLITES PRESENCE MAINLY IN SEVERAL TI ALLOYS
	GOOD SPHERICAL SHAPE OF POWDERS	
		NO CUSTOMIZATION OF CHEMISTRY
		HIGH COST OF RAW MATERIALS
		LOW AVAILABILITY OF RAW MATERIALS
PLASMA	VERY GOOD SPHERICAL SHAPE	LOW PRODUCTIVITY
	PRODUCTION OF SMALL LOTS OF POWDER	HIGH CONSUMPTION OF ENERGY
	REACTIVE ALLOYS PRODUCTION	HIGH CONSUMPTION OF GAS
	HIGH POWDER PURITY	LOW YIELD FOR SMALLER SIZES
	VERY LOW PRESENCE OF SATELLITES	HIGH PRODUCTION COST
	VERY GOOD FLOWABILITY	LOW AVAILABILITY OF RAW MATERIALS
		HIGH COST OF RAW MATERIALS



# NUMANOVA S.p.A.



## METALLIC POWDERS PRODUCTION

# NUMANOVA: THE PRODUCTION



EIGA plant installed in NUMANOVA transforms metallic bars into extremely pure spherical shaped powders by means of inert gas atomisation process



**Impianto EIGA - Electrod Induction Gas Atomisation**



**Annual Production: 250 t**

# ASSET OVERVIEW: INERT GAS ATOMISATION

Gas impacts molten metal stream spreading it into small particles rapidly solidifying into spherical shape



Electrode's induction melting



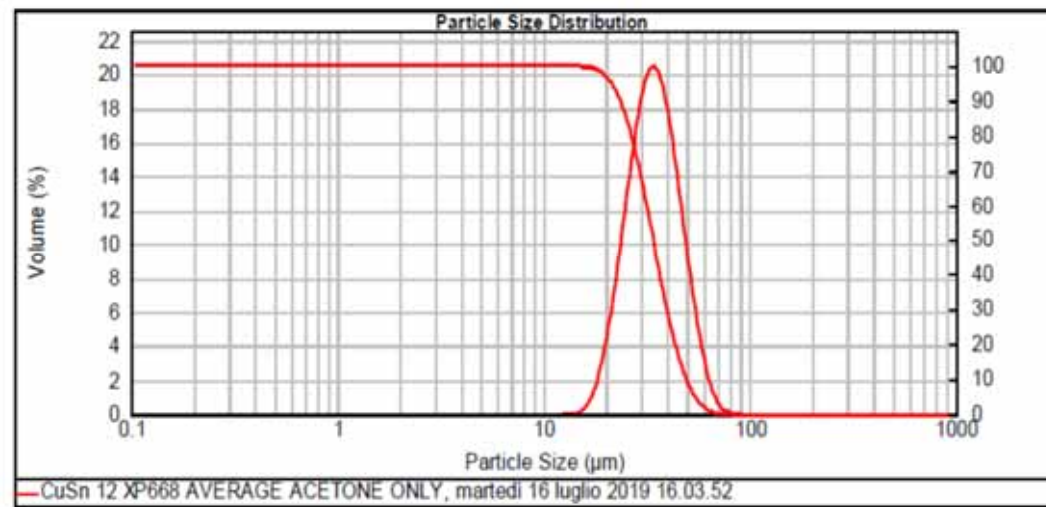
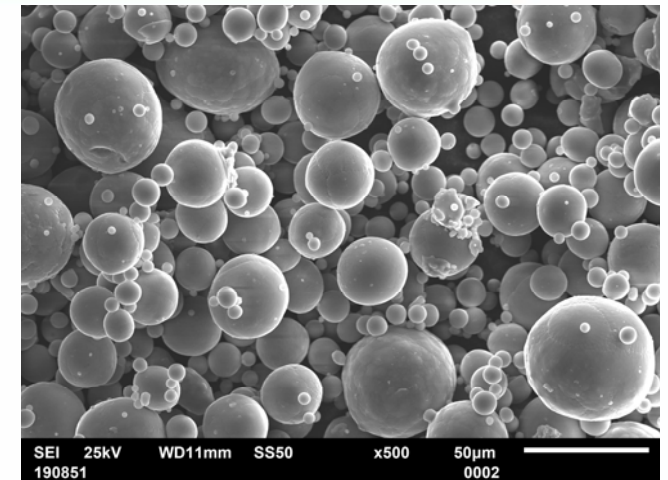
Argon or  
Nitrogen  
Atomisation



# ASSET OVERVIEW – SIEVING DEPARTMENT



After atomization, powders are sieved to obtain the suitable granulometric distribution for each application





# PRODUCTS



## PRODUCTS LIST

**NUMANOVA Titanium Alloys:** Ti23 (grade 23), Ti5 (grade 5), Ti2 (grade 2), Ti4 (grade 4) and TiAl.

**NUMANOVA Iron Alloys:** AISI 316L, 15-5 PH, 17-4 PH, 13-8 Mo, F51, H13.

**NUMANOVA Copper Alloys:** Cu\_OFE, CuSn alloys, CuBe alloys, CuCrZr, Aluminium bronze, CuZn Alloys.

**NUMANOVA Aluminum Alloys:** AlSi7Mg, AlSi10Mg, AlSi9Cu3, AlSi12, 7075.

**NUMANOVA Nickel Alloys:** In718, In625, In713LC, Hastelloy X, Hastelloy C.

**NUMANOVA Cobalt Alloys:** CoCrF75, Stellite 6, Stellite 12



# FOR FURTHER INFORMATION



**[WWW.NUMANOVA.COM](http://WWW.NUMANOVA.COM)**

**TWITTER: [@NUMANOVASPA](https://twitter.com/NUMANOVASPA)**

**FACEBOOK: [WWW.FACEBOOK.COM/NUMANOVASPA](http://WWW.FACEBOOK.COM/NUMANOVASPA)**

**LINKEDIN: [WWW.LINKEDIN.COM/COMPANY/NUMANOVA](http://WWW.LINKEDIN.COM/COMPANY/NUMANOVA)**

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