



## Vacuum Induction Melting Inert Gas Atomization





# About Consarc

Consarc Corporation, located in New Jersey, USA, and Consarc Engineering Ltd, located in Scotland, UK, are part of the Inductotherm Group of companies, the leading world suppliers of induction heating and melting equipment. Whether you're melting, remelting, casting, brazing, or atomizing, Consarc has a solution for you.

## EXPERIENCE

For over 60 years, Consarc has been designing custom vacuum furnaces and engineering solutions for the aerospace, energy, technology, and defense sectors. From our first Vacuum Arc Remelting Furnace in 1963 to the world's largest singleelectrode Electroslag Remelting Furnace produced in 2010, Consarc has been providing the most advanced solutions to vacuum metallurgy at every step of the way. Our industry-leading measurement and control systems and automated process technology demonstrate our continual commitment to innovation and improvement.

Hundreds of Consarc furnace installations around the world attest to our proven ability to design and deliver high-performance vacuum furnaces for the world's most advanced materials. Consarc offers a wide range of furnace sizes, configurations, and options to ensure that every installation not only meets the purchaser's requirements, but is also suitable to use for decades to come.

## SUPPORT

We believe that if our customers are successful, then we will be successful too. This partnership approach is present throughout the furnace design, testing, and delivery process, and continues with after-sales support to develop, carry out, and troubleshoot customers' processes.

Consarc has a global technology team dedicated to advancing our furnace technology and supporting our customers with their processes. Technical staff have far-reaching backgrounds in research and production of various materials, processes, and processing equipment. Many services are offered including melt profile development and optimization, 2D/3D modeling, operator training, and onsite troubleshooting assistance.

## FLEXIBILITY

If more than 60 years of experience across hundreds of furnace designs has taught us anything, it's that one size does not fit all. That's why we specialize in custom furnace solutions that are tailored to meet customers' unique needs and requirements. Whether you're looking for an upgrade or a furnace customized for a specialized application, we've got you covered.

Our experienced team of engineers and designers will work closely with your engineers, metallurgists, and maintenance personnel to understand your specific requirements and develop a furnace that meets those exact specifications. With our custom solutions and careful guidance, you can be confident that you're getting the best possible fit for your needs, without any unnecessary compromises.

In a world where everyone seems to be looking for a quick fix or an off-the-shelf solution, we believe that there's still value in taking the time to do things right. Contact us today to learn more about our custom solutions and how they can benefit your business.



# VIM-IGA The Process

Vacuum Induction Melting Inert Gas Atomization (VIM-IGA) is used to produce fine, spherical metal powders for use in a variety of applications, including additive manufacturing (AM) and metal injection molding (MIM). The process involves atomizing a liquid metal into a spray of droplets that solidify into uniform powder particles.

Consarc VIM-IGA furnaces melt charge material under vacuum in an induction furnace. When the desired atomizing conditions are met, the molten metal is precisely poured into a heated tundish positioned above the atomizing tower. A nozzle at the bottom of the tundish creates a stream of molten metal that descends into the atomizing jet, where it intersects with high-pressure gas. The force of the gas breaks the stream, atomizing the metal into fine droplets that rapidly cool and solidify into particles. The resulting particles are spherical in shape and can be tailored in size for specific applications.

The solid particles generated during the atomizing process fall to the base of the chamber for collection. Smaller particles are separated from the exhaust gas stream with a cyclone-style separator. The chamber is vacuum tight to prevent oxidation of the metal droplets and preserve the purity of the alloy powder, allowing for the production of oxygen-sensitive and reactive alloys such as Ni and Co-based superalloys.



## **APPLICATIONS**

Metal particles produced through VIM-IGA furnaces find applications in many industries. Some common applications include additive manufacturing, metal injection molding, hot isostatic pressing, and thermal spray coatings. Vacuum melting facilitates the production of a wide range of alloys including:

- nickel superalloys •
- maraging steels
- cobalt superalloys •
- low-alloy steels copper
- stainless steels tool steels

.

- high-entropy alloys
- **ADDITIVE MANUFACTURING (AM)**

Metal powders produced through VIM-IGA are spherical in nature, resulting in high flowability which makes them ideal for powder bed and powder-blown AM applications. These powders are used as feedstock in AM processes, which allows for production of complex metal parts directly from the powder, enabling rapid prototyping and customized maufacturing. The particle size distribution can be tuned to tailor yeilds for various AM production methods, such as laser powder bed fusion, binder jet printing, electron beam melting, and blow powder direct energy disposition.

#### **METAL INJECTION MOLDING (MIM)**

Atomized metal powders are commonly used in MIM due to their fine particle size, spherical shape, and uniform chemical composition. These characteristics allow for better flowability and packing of the powder within the mold, resulting in higher density and improved dimensional accuracy of the final parts.

#### **HOT ISOSTATIC PRESSING (HIP)**

The controlled chemical composition and particle size of VIM-IGA make them well suited for high-performance applications and processing of unique alloys that are difficult to shape via other methods. HIP is used to produce near-net-shape parts and grain-size-controlled ingots for specialty forging applications.

### **THERMAL SPRAY**

Metal powders are used in thermal spray processes, where they are heated and propelled onto a surface to create a coating. These coatings provide protection against wear, corrosion, and high temperatures.



#### **ATOMIZATION PROCESS**



## Inside VIM-IGA





VIM Furnace Pour



Induction-Heated Tundish and Gas Jet

- Immersion Thermocouple Α
- Overmelt Charger В
- Melt Chamber С
- Induction Furnace D
- E Heated Tundish
- F Gas Jet
- Atomizing Tower Cyclone Separator G
- Н
- Powder Collection L



Anti-Satellite Gas System

## CONSARC VIM-IGA ADVANTAGES

## Anti-Satellite Gas System

- Reduced satelliting, resulting in spherical particles with high flowability and spreadability
- Collected powder is cooler, reducing caking and allowing for immediate downstream processing

## **Industrial Production Design**

- Designed for faster decontamination between alloy changes
- Easier access to consumables and critical maintenance components

## **Semi-Continuous Processing**

## **Revert Powder Remelting**

- Remelting of off-spec powder allows for high rates of utilization, minimizing inefficiencies inherent in the powder production process
- Capable of remelting recycled powder
- Advanced powder feeding system for minimized dusting and bridging

## **Hot Gas Atomization**

- Fine particle size distribution
- Lower gas consumption rates

Standard VIM-IGA designs have integrated melting and atomizing chambers that are vacuum-sealed together for batch-type processing. Consarc offers a multi-furnace, semi-continuous VIM-IGA design wherein melting of subsequent heats can begin immediately after atomization while the tundish is changed and pre-heated for another pour. Furnaces remain in vacuum or inert atmospheres at all times, effectively extending lining life, minimizing downtime, and eliminating pickup of oxygen and nitrogen from the atmosphere.

## AVAILABLE FEATURES

- Tundish Exchange
- Melt Dump Pot
- Induction or Resistance Heated Tundish
- Vacuum Isolated Melt Chamber
- Overmelt Bulk Charger
- Revert Powder Charger
- Anti-Satellite Gas System
- Hot Gas System
- In Situ Video System



## Why VIM-IGA?

Vacuum Induction Melting Inert Gas Atomization furnaces offer many advantages in the production of metal powders.

## **HIGH PURITY**

Inert gas atomization enables production of high-purity metal powders. Vacuum induction melting enables the processing of alloys that would otherwise react with an air atmosphere and provides the additional opportunity for refining of the melt, allowing very low oxygen and nitrogen contents to be achieved. The use of inert atomizing gases aids in minimizing oxidation and contamination during the atomization process. This is particularly important for sensitive metals and alloys that are prone to oxidation or require high purity for specific applications, such as aerospace or medical devices.

## FINE PARTICLE SIZE AND CONTROLLED DISTRIBUTION

Inert gas atomization enables the production of fine metal powders with controlled particle size distribution. The process can be optimized to achieve a specific range of particle sizes to maximize production yeilds. This control over particle size is crucial for applications that require precise control of powder characteristics, such as additive manufacturing or advanced coating processes.

## SPHERICAL PARTICLE SHAPE

Gas atomization produces metal powders with a spherical or near-spherical particle shape. Spherical particles have several advantages, including improved flowability, higher packing density, and a more uniform distribution within a matrix. These characteristics are highly desirable for powder metallurgy processes, such as metal injection molding or powder bed fusion in additive manufacturing.

#### **HOMOGENITY AND CONSISTENCY**

VIM-IGA provides excellent chemical homogeneity and physical consistency in the resulting metal powders. The process ensures uniform cooling and solidification of atomized droplets, leading to consistent particle size, shape, and composition throughout the powder batch. This uniformity is crucial for achieving consistent properties in the final manufactured components.

#### VERSATILITY

VIM-IGA can be used with a wide range of metals and alloys, including ferrous and non-ferrous materials. It offers flexibility in terms of the types of materials that can be processed, enabling production of metal powders with diverse compositions and properties.





Consarc VIM-IGA Furnace Design

## **EXPERIENCE AND LONGEVITY**

Consarc has a wealth of experience manufacturing robust equipment designed for long service life and continual operations.

- We have been designing and delivering Vacuum Induction Melting furnaces for more than 60 years.
- Vacuum Induction Melting furnaces have been installed with capacities from <5 kg to 30,000 kg.
- Consarc's first VIM-IGA furnace was manufactured in 1969 and remains in operation to this day.

# Solutions at every step

## Primary Melting

Vacuum Induction Melting (VIM) is the first step in creating metals used in the most demanding applications. A VIM furnace incorporates an induction furnace within a vacuum chamber in order to prevent oxidation of volatile elements during the melting and refining stages. The end result of the process is a high purity metal with a homogenous chemical composition for use in secondary processing. Once molten and fully refined, the molten metal is passed through a preheated tundish for a final refinement before entering into ingots for further processing.



Masteralloy Vacuum Induction Melting Furnace (VIM)



Electrode Vacuum Induction Melting Furnace (VIM)

## Secondary Processing

Remelting and casting are secondary melting processes used to further refine and improve the quality of materials produced from primary melting. During the remelting processes, a metal alloy ingot is melted in a controlled atmosphere environment to remove impurities and/or improve the macro and microstructure of the ingot or cast part, depending on the final application. The hallmark of secondary melting is not the melting but rather the controlled solidification which is what gives the final product its refined structure for use in high-temperature and high-stress applications.



Electroslag Remelting Furnace (ESR)



Vacuum Arc Remelting Furnace (VAR)



Vacuum Precision Investment Casting Furnace (VPIC)

## Thermal Processing

Vacuum Aluminum Brazing (VAB) is a specialized process used to join aluminum components using a brazing alloy in a vacuum environment. Brazing is commonly used to join metal parts that are difficult or impossible to weld using traditional welding techniques. Other thermal processing options are also available from Consarc, designed to fit customers' specific process needs.



Vacuum Aluminum Brazing Furnace (VAB)



Vacuum Heat Treat Furnace (VHT)

## Specialized Melting

Consarc offers a wide range of additional melting options. Inert Gas Atomization furnaces are used to produce metal powders with high purity and controlled particle size distribution. Vacuum Cap furnaces are versatile units capable of vacuum degassing and controlled-atmosphere melting operations.



Vacuum Inert Gas Atomization Furnace (VIGA)



Vacuum Cap Furnace (VCAP)



#### ONE SIZE DOES NOT FIT ALL

Considering a stock furnace option that doesn't meet your exact needs? Why not consider a custom designed Consarc furnace?

Our team of experts works with you to create tailored solutions that fit your unique requirements. We don't believe in a one-size-fits-all approach - every project is different, and we take the time to understand your specific needs before designing a furnace that meets them perfectly.

Our commitment to collaboration and flexibility set us apart from other furnace manufacturers. You'll have input every step of the way, ensuring that the final product is exactly what you need. Plus, our flexible approach means that we can adapt to changes and make adjustments as needed.

Experience the difference a custom Consarc furnace can make. Get in touch with us today!



# We can help you do great things with metal.

Give us a call or send us a note. Telephone: +1 609 267 8000 | +44 (0)1698 730430 Email: sales@consarc.com | sales@consarceng.com



Consarc Corporation 100 Indel Avenue Rancocas, NJ USA 08073 www.consarc.com

#### Consarc Engineering Ltd. 9 Woodside, Eurocentral Lanarkshire, UK ML1 4XL www.consarceng.com