INDUCTOTHERM GROUP

Vacuum Induction Melting Furnaces

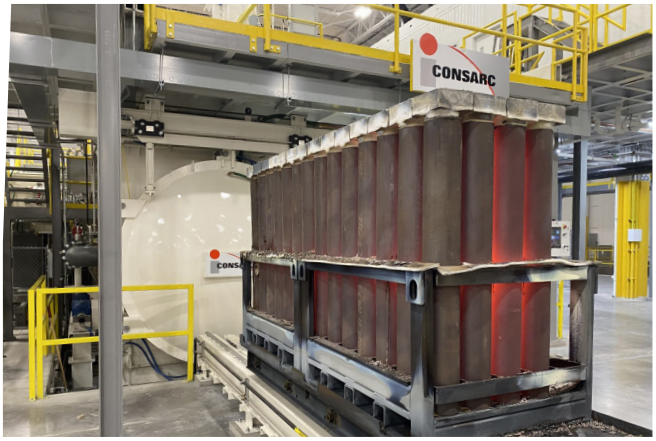
CONSARC

VIM Process

Vacuum Induction Melting (VIM) is the melting of metal via electromagnetic induction under vacuum. An induction furnace, with coil specially insulated for operation in vacuum, is mounted on a tilting stanchion located within a vacuum chamber. The induction furnace is connected to a low voltage induction power supply at a frequency precisely correlating to the furnace size and material being melted.

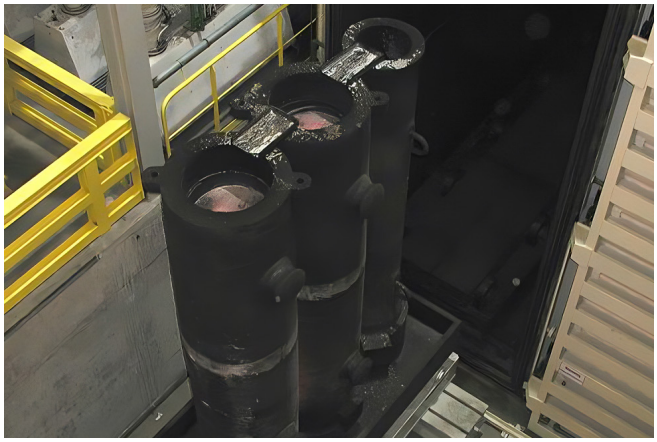
Solid material is charged into the induction furnace under vacuum, via the valve-isolated charging locks, and power is then applied to melt the charge. Additional charges are added to bring the liquid metal volume to the furnace melt capacity. The molten alloy is refined under vacuum and the chemistry is adjusted until the precise melt chemistry is achieved. When the target melt chemistry is achieved, the melt temperature is adjusted while a heated tundish is inserted through a valve-isolated hot tundish insertion lock. With the melt at the pouring temperature and refractory tundish positioned in front of the induction furnace, the molten alloy is poured through the tundish into the awaiting molds.

Masteralloy



Heat sizes to 10+ tons

Electrode



Heat sizes to 30+ tons

Consarc has built the majority of the large VIM systems in production today wordwide. Companies producing the best masteralloy barstock for precision casting or electrodes for remelt operations are doing so in Consarc VIM furnaces.

FEATURES

- Rugged Inductotherm Steel Shell Induction Furnaces
- Rapid-exchange features for maximum productivity
- Efficient Inductotherm power supplies and auxillary stirring
- Multiple chamber systems: mold chambers, charging chambers, and hot tundish insertion chambers
- Multiple charging systems for rapid feeding of charge material
- Multiple mold pouring via mold cars or turntables
- Low conductance “wet” filters to protect vacuum pumps and minimize fire hazards
- Intuitive PC-driven and PLC-based controls with full SCADA
- Remote operation via CCTV

Chamber Design

Consarc designs static VIM melting chambers which are adequately-sized and designed to operate continuously in harsh, high-heat envinronments. The system is designed to operate for many consecutive melting cycles without the need to break vacuum for cleaning or furnace-charging between melts. This simple design philosophy ensures that the VIM furnace offers the highest possible productivity in operation.

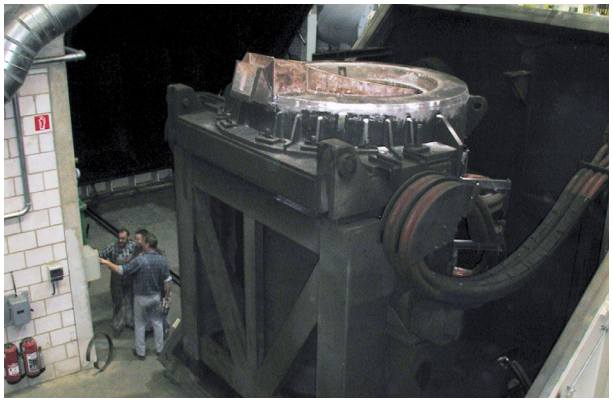
Access to the melt chamber and the induction melting unit can be accomplished in two ways:

Rollaway Head

- Good access to the furnace top and spout
- Simple power supply bus
- Good ability to inspect the lining and coil
- Ability to frit lining in open air

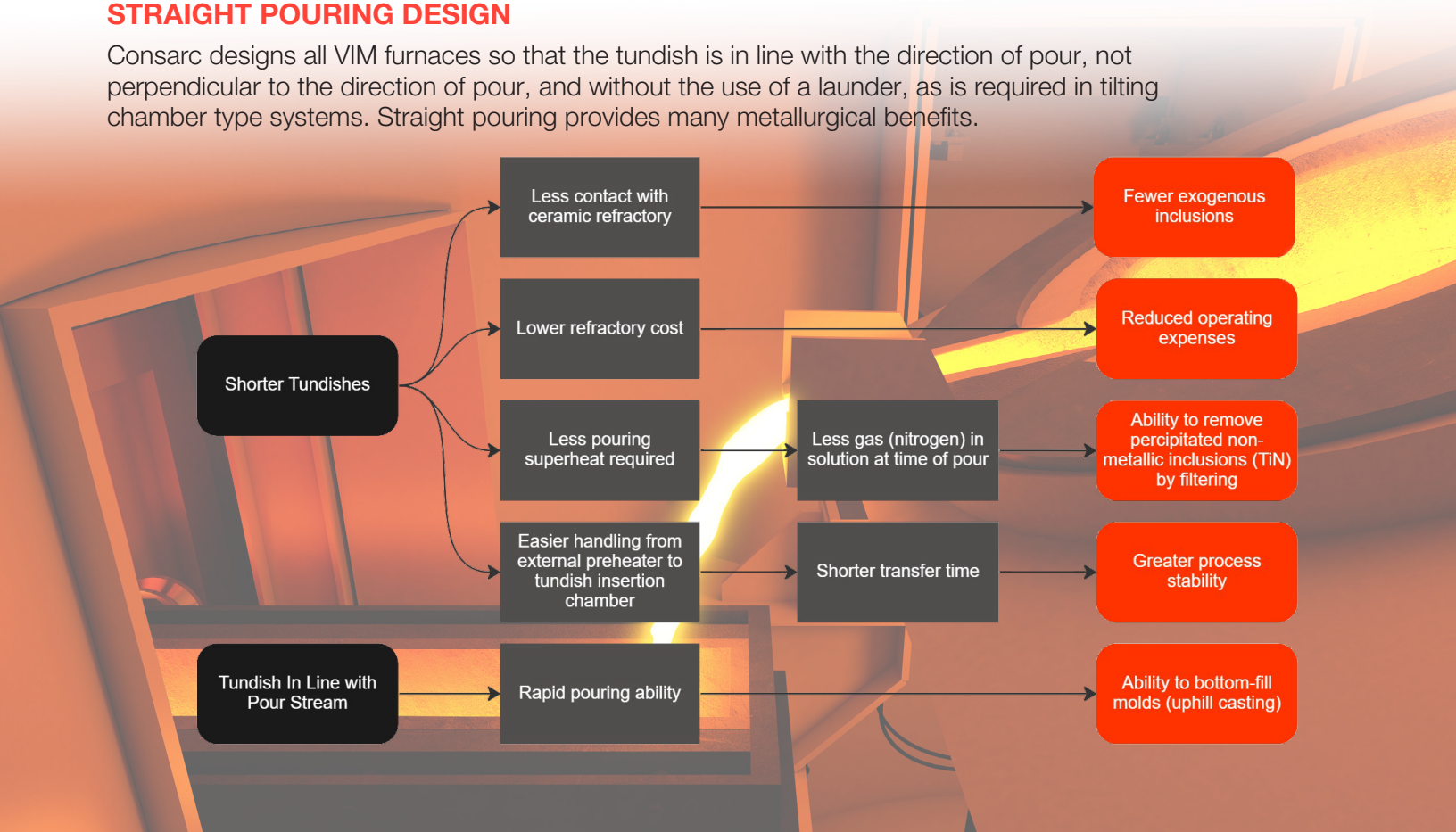
Door-Mount

- Very easy access to melt chamber for cleaning
- Easy access to the induction coil
- Less platforming required
- Ultra-rapid exchange systems



STRAIGHT POURING DESIGN

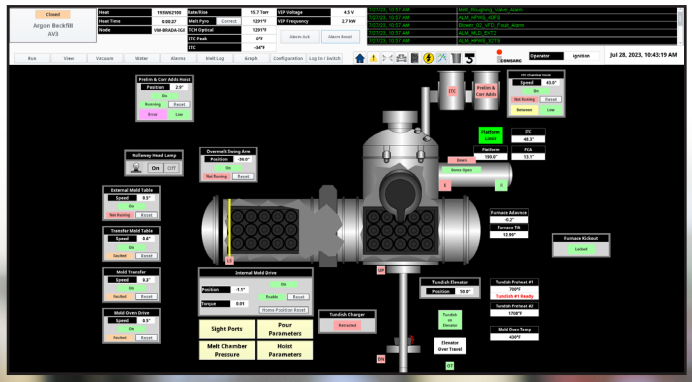
Consarc designs all VIM furnaces so that the tundish is in line with the direction of pour, not perpendicular to the direction of pour, and without the use of a launder, as is required in tilting chamber type systems. Straight pouring provides many metallurgical benefits.



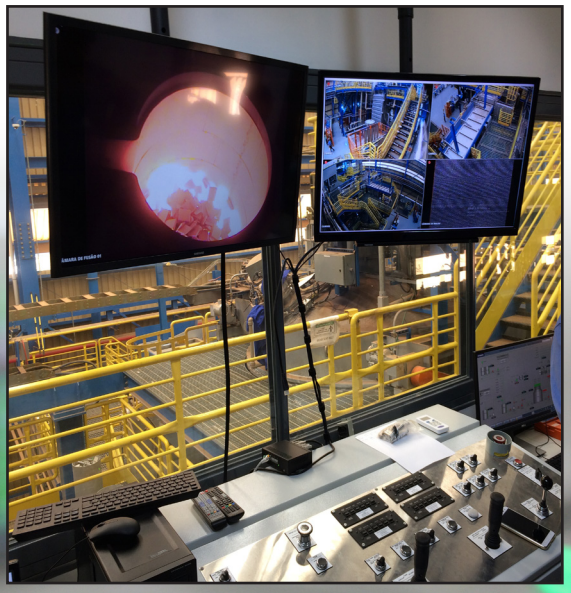
VIM Controls

Consarc has developed and implemented its latest generation of VIM controls into every furnace - complete with multiple monitors and remote CCTV system. The controls architecture is designed with operator safety first and foremost. By creating a defined operation station removed from the furnace, the operators can safely melt, pour, and fill molds from the safe area of an enclosed control room. The multi-camera system, with redundant sight glasses and cameras in critical locations, not only enables safe operation of the furnace but also the ability to record and review melt history to improve operation of the furnace or for training of new operators.

The PC-based SCADA (System Control And Data Acquisition) system utilizes multiple monitors to allow for simultaneous operation of the machine while monitoring trends on the data acquisition system. A wide range of customization options are available to operators for ease-of-use. Operating alongside the Human-Machine-Interface PC is a fully-integrated Programmable Logic Controller (PLC) with a full compliment of safety interlocks to prevent unintended operation of the VIM Furnace. Along with sensors and switches throughout the furnace, this arrangement provides the end user with the most capable VIM equipment on the market today.



PC Human-Machine Interface



Multi-Camera System

Charging Design

Charging a VIM furnace is one of the most critical steps in furnace productivity and safety. Consarc believes that carefully-selected and designed charging systems allow VIM furnaces to operate at peak productivity and minimum downtime. To achieve maximum productivity, Consarc employs two different charging techniques for charging the VIM furnace.

Overmelt Charging

Perhaps the most ubiquitous type of charging method, a valve isolated chamber sits on top of the vacuum furnace chamber aligned with the centerlines of the induction furnace below it. Between the chambers is a water-cooled valve to prevent any ill effects of thermal radiation on the seal plate. Material is placed in the chamber and secured by a hoist. After the material is secured, the chamber can be closed and vacuum pumps can evacuate the chamber. After the pressure is equalized between the two chambers, the valve opens and the hoist lowers to drop its charge inside the induction furnace. After the charge is released, the hoist is retracted, valve closed, and the charge chamber is allowed to vent to atmospheric pressure for it's next task.

Overmelt Charger

Vibratory Feeder With Charge Material

Side Charging

Side charging is the preferred way to charge a VIM furnace when the charge material is investment casting returns, shot, or other small materials with low packing densities. The low packing density requires the materials be charged in a slow and controlled manner such that too much solid material does not collect above the melt line. Using a vibratory feeder Consarc's side charging system can precisely control the rate of charge material, including stopping charging and retracting the feeder into its own vacuum isolated chamber. This method of charging allows the user to charge material at a similar rate over a given period of time and also provides redundancy in charging for maximum productivity.

Masteralloy VIM Systems

Masteralloy VIM Mold Chamber

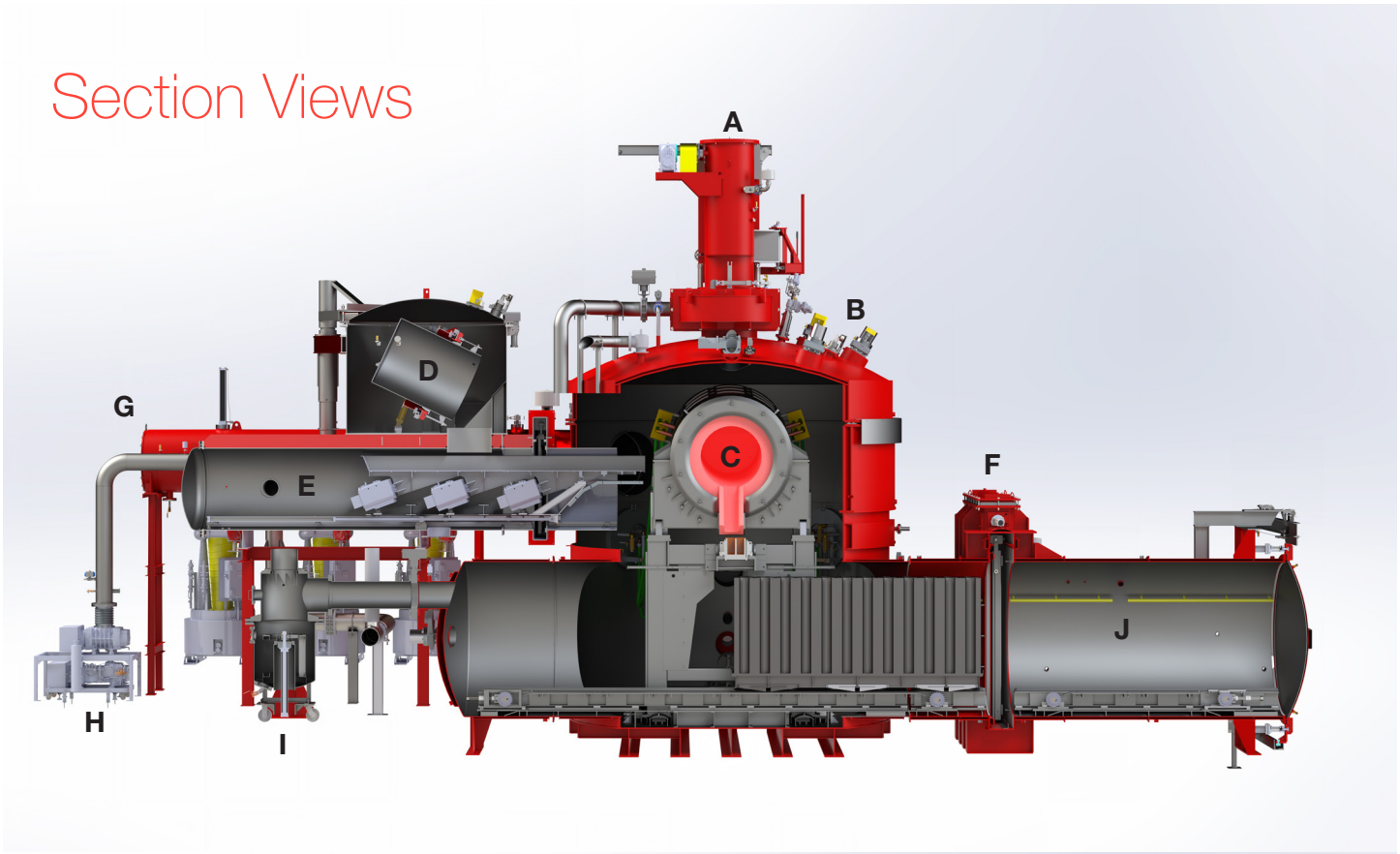

New Masteralloy Ingots

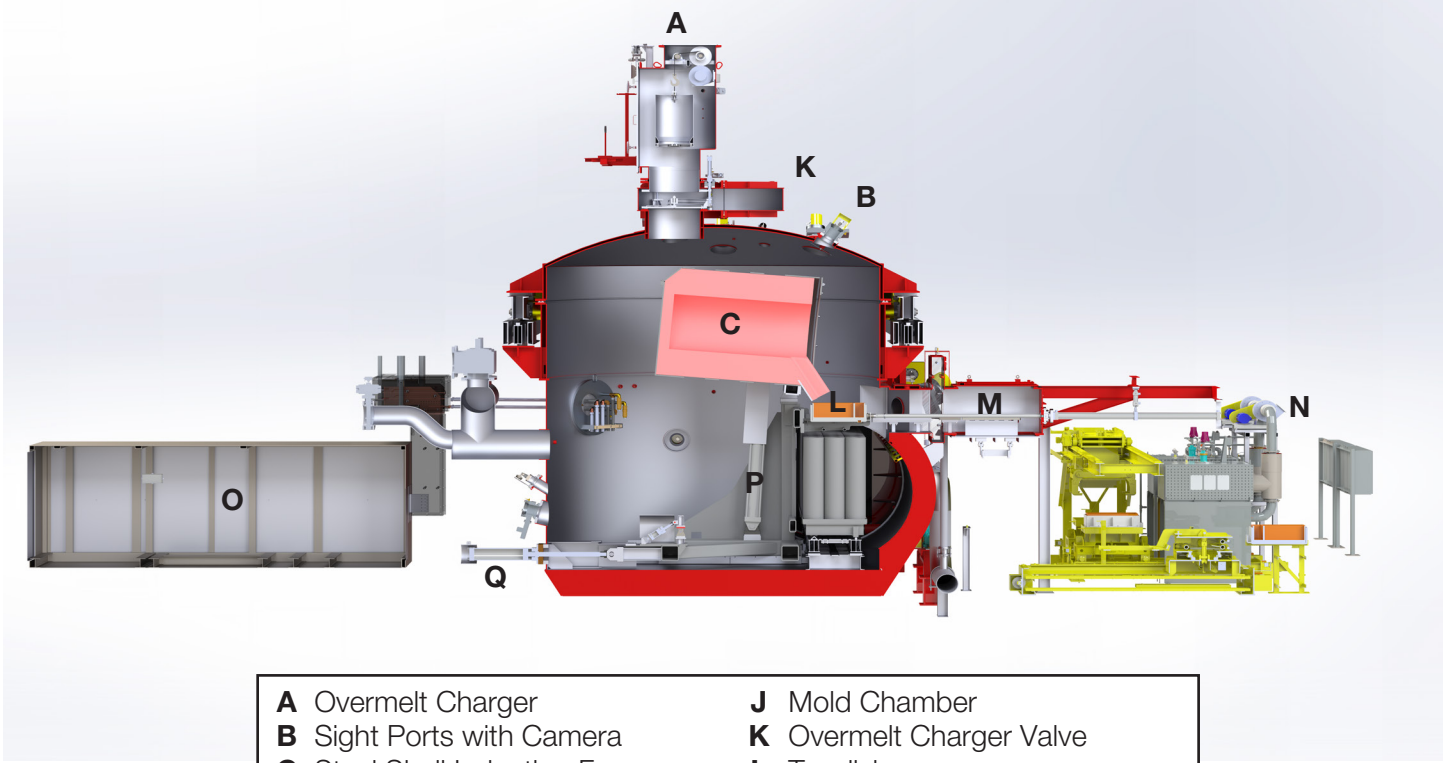
Masteralloy VIM systems are generally in the range of 1 to 10 tons and are characterized by their ability to pour many multiples of smaller diameter ingots configured on a mold car or turntable. Masteralloy ingots are commonly as small as 2⅞" (73 mm) or as large as 10" (254 mm) in diameter, and are generally ≈60" (1.5m) tall.

MASTERALLOY VIM FEATURES

- Vibratory Side Feeder for primary charging of low density charge materials like casting returns, gates, risers, and sprues
- Overmelt Charger for primary bucket charging of high density charge materials like balls and briquettes, temperature probe insertion, sample taking, and late alloy additions
- Custom designed water-cooled overmelt isolation valves incorporating vacuum seal protection when open for increased reliability
- Uni-directional Stirring (UDS)
- Three-stage vacuum pumping system incorporating oil-sealed rotary pumps or dry type screw pumps, roots-type mechanical blowers, and oil vapor booster pumps for final vacuum levels in the 10^{-3} torr/mbar range
- Oil-wetted vacuum filters for control of pyrophoric additions such as NiMg
- State-of-the-art safety systems incorporating overpressure relief valves and argon purging
- Hot Tundish insertion chargers configured to insert an externally preheated refractory tundish into the pour position within a few minutes
- Multiple ingot row pouring by furnace/tundish advance or mold turntable advance
- Programmable control of mold car/turntable movement
- Forced gas cooling
- Computerized control and SCADA systems
- Rapid Exchange Furnace Systems allow a hot furnace to be removed with external cooling and a second reheated furnace to be installed quickly, without the need to make or break furnace tilt connections or insulated electrical connections.

Section Views





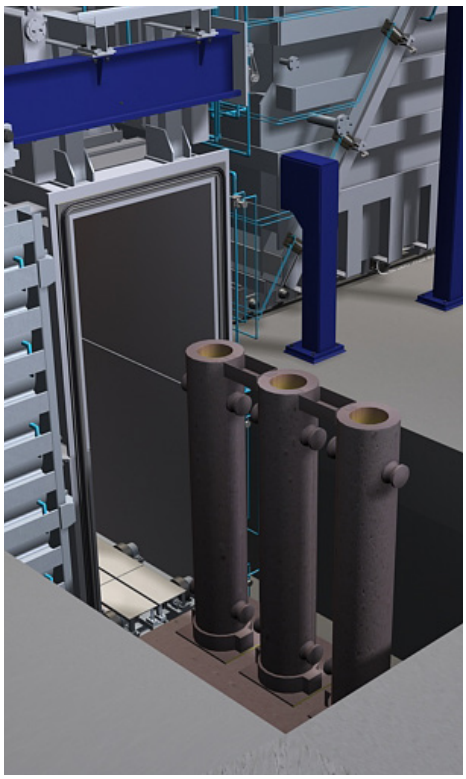
A	Overmelt Charger	**J**	Mold Chamber
B	Sight Ports with Camera	**K**	Overmelt Charger Valve
C	Steel Shell Induction Furnace	**L**	Tundish
D	Drum Charger	**M**	Tundish Charging Chamber
E	Vibratory Horizontal Feeder	**N**	Tundish Insertion System with Heaters
F	Mold Chamber Isolation Valve	**O**	Induction Power Supply
G	High Vacuum System	**P**	Furnace Tilt Cylinder
H	Roughing Vacuum System	**Q**	Furnace Advance Cylinder
I	Oil Bath Filter		

Electrode VIM Systems

Electrode VIM systems are the largest VIM systems produced. Some furnaces exceed 30-ton capacity. Electrode VIMs typically pour several electrode mold setups which could be as much as 200” (5 m) in length. Top cast and uphill cast mold setups can be accomodated.

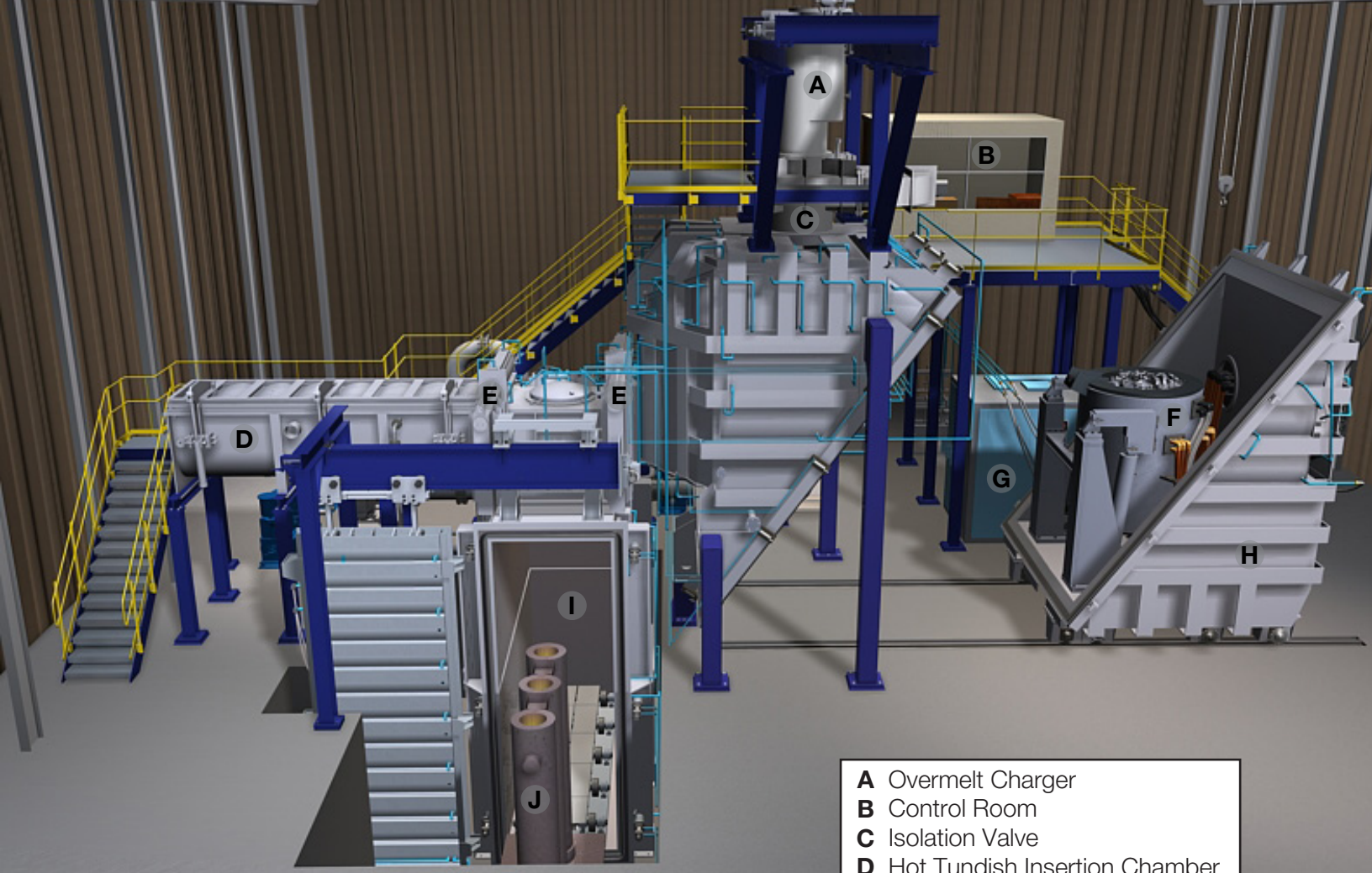
ELECTRODE VIM FEATURES

- Vibratory Side Feeder for primary charging of low density charge materials like casting returns, gates, risers, and sprues
- Large Capacity Overmelt Charger for primary bucket charging of high density charge materials like balls and briquettes
- Charge weights up to 5 tons are possible depending on the furnace refractory dimensions. Large capacity chargers incorporate dual hoists, allowing opening of charge buckets
- Custom-designed water-cooled overmelt isolation valves to over 54” (1.37 m) in diameter incorporating vacuum seal protection when open for increased reliability
- Secondary overmelt devices for temperature probe insertion, sample taking, and late alloy additions
- Frequency Modulated (FM) or Unidirectional Induction Stirring (UDS)
- Three-stage vacuum pumping system incorporating oil-sealed rotary pumps or dry-type screw pumps, roots-type mechanical blowers, and oil vapor booster pumps for final vacuum levels in the $10^{-2/-3}$ torr/mbar range
- Oil-wetted vacuum filters for control of pyrophoric additions such as NiMg
- Large Electrode VIM systems may incorporate Steam Ejector or Steam Hybrid vacuum pumping systems
- State-of-the-art safety systems incorporating overpressure relief valves and argon purging
- Hot Tundish insertion chargers configured with dual vertical isolation valves such that metal is poured in between valves rather than through valves
- Deep tundishes on large furnaces can contain stopper rod assemblies
- Computerized control and SCADA systems
- Rapid Exchange Furnace Systems allow a hot furnace to be removed with external cooling and a second reheated furnace to be installed quickly, without the need to make or break furnace tilt connections or insulated electrical connections



Electrode Molds on Trolley Car

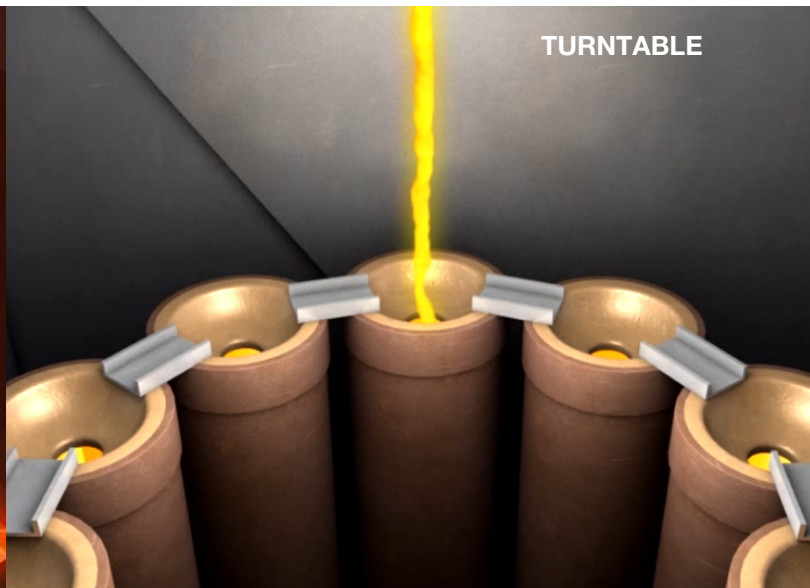
VIM FIlling Electrode Molds



A Overmelt Charger
B Control Room
C Isolation Valve
D Hot Tundish Insertion Chamber
E Isolation Valves
F Induction Furnace
G Induction Power Supply
H Wedge-Style Melt Chamber
I Mold Chamber
J Electrode Ingot Molds

Mold Chamber

Electrode VIM furnaces can be designed with either a trolley car style or turntable mold chamber. Turntables are typically less complex and are suitable for multiple smaller-diameter molds. Trolley car mold tables can easily accommodate large-diameter electrodes and are best suited for uphill casting setups.



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!

CONSARC
An Inductotherm Group Company

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ABOUT CONSARC

For more than 60 years, Consarc Corporation (USA) and Consarc Engineering Ltd (UK) have been designing vacuum induction furnaces and engineering solutions for the world's most advanced materials. We believe in a partnership approach that is present through furnace design, testing, delivery, and comissioning, but it doesn't stop there. Consarc offers after-sales support for troubleshooting, process optimization, and spare parts.

In addition to a field engineering team, Consarc has a global technology team dedicated to advancing furnace technologies and optimizing machine performance. Our 'tech team' staff have far-reaching backgrounds in research and production of various materials, processes, and processing equipment. Many services are offered including full Technology Packages, melt profile development, process optimization, operator training, and metallurgical consulting.

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

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