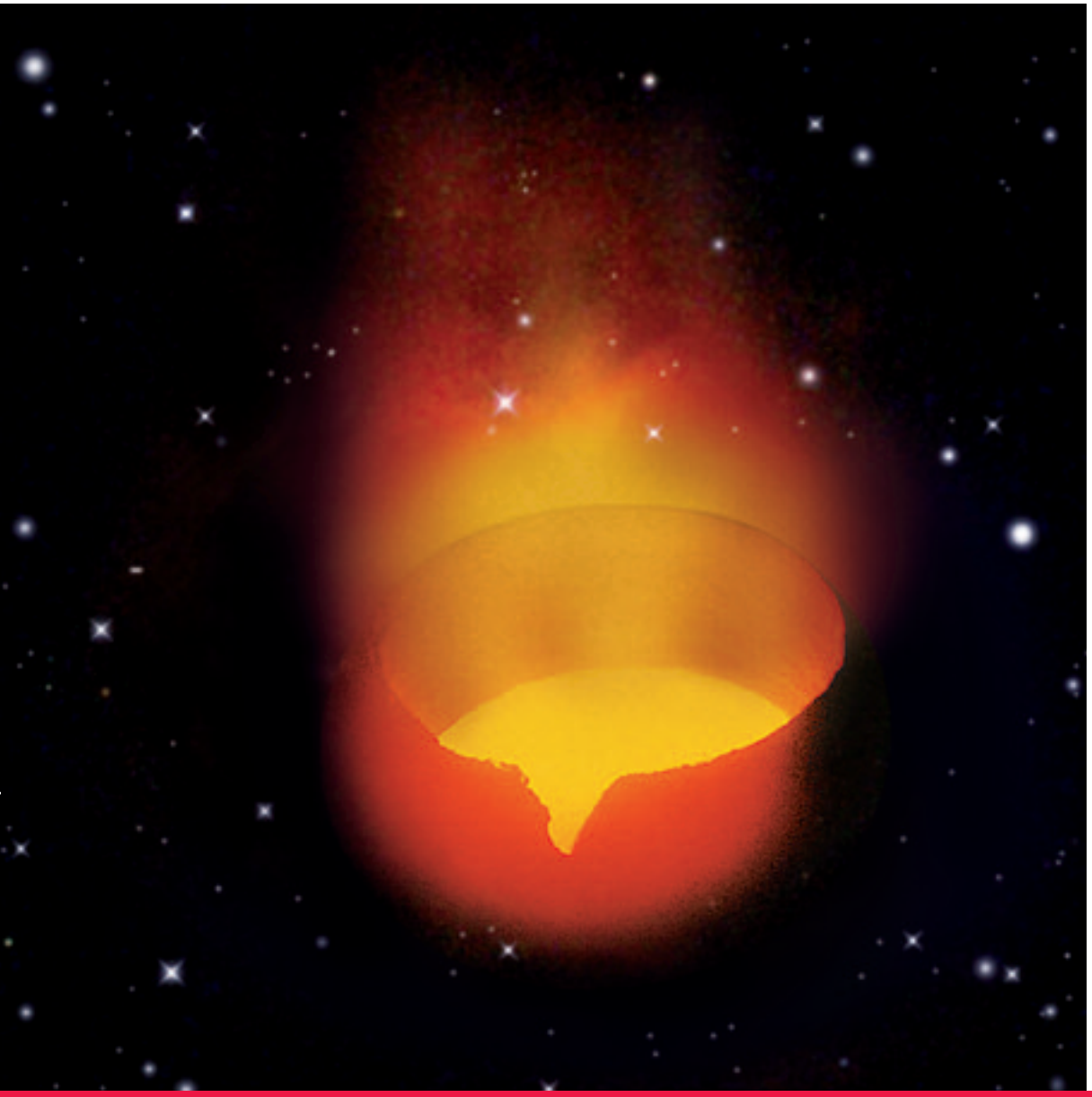


The Solution

VIM

Vacuum Induction Melting and Casting Furnaces

VIM 100 to VIM 3000

Vacuum Induction Melting and Casting:

Vacuum induction melting is one of the most common processes in secondary metallurgy. It makes possible the effective degassing of the melt and precise adjustment of alloy composition.

The application of vacuum in the induction melting process is indispensable for the production of high purity metals that react with atmospheric oxygen. The vacuum melting process limits the formation of non-metallic oxide inclusions that are responsible for premature part failure.

Particularly critical applications such as jet engine parts demand the production of alloys with a very low concentration of undesired volatile trace elements.

VIM Process Characteristics:

- Environmental friendly
- High flexibility and versatility
- Fast process change
- High efficiency due to optimum refining
- Close compositional tolerances
- Precise temperature control
- Removal of undesired elements

Vacuum induction melting enables an extremely precise adjustment of the alloy composition and melt homogenization since

- melt temperature,
- vacuum,
- gas atmosphere,
- pressure and
- kinetics

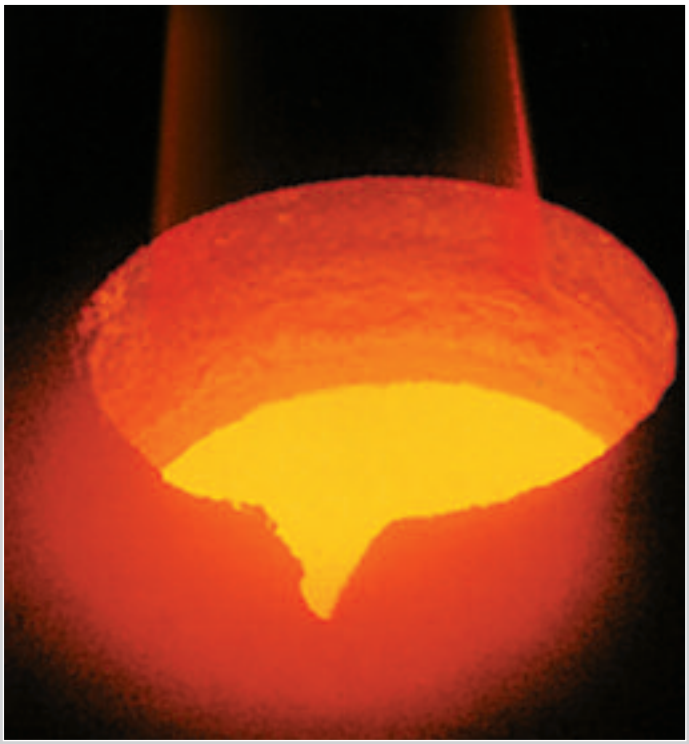
can be adjusted independently.
Several casting processes can be combined with VIM technology.

Applications:

- Special steels, superalloys and nonferrous alloys
- Semi-finished products, such as:
  Electrodes for remelting
  Ingots for wrought products
  Bar stock for investment casting

Final Products are used for:

- Aerospace
- Power generation
- Electronics
- Chemical
- Medical
- Automotive

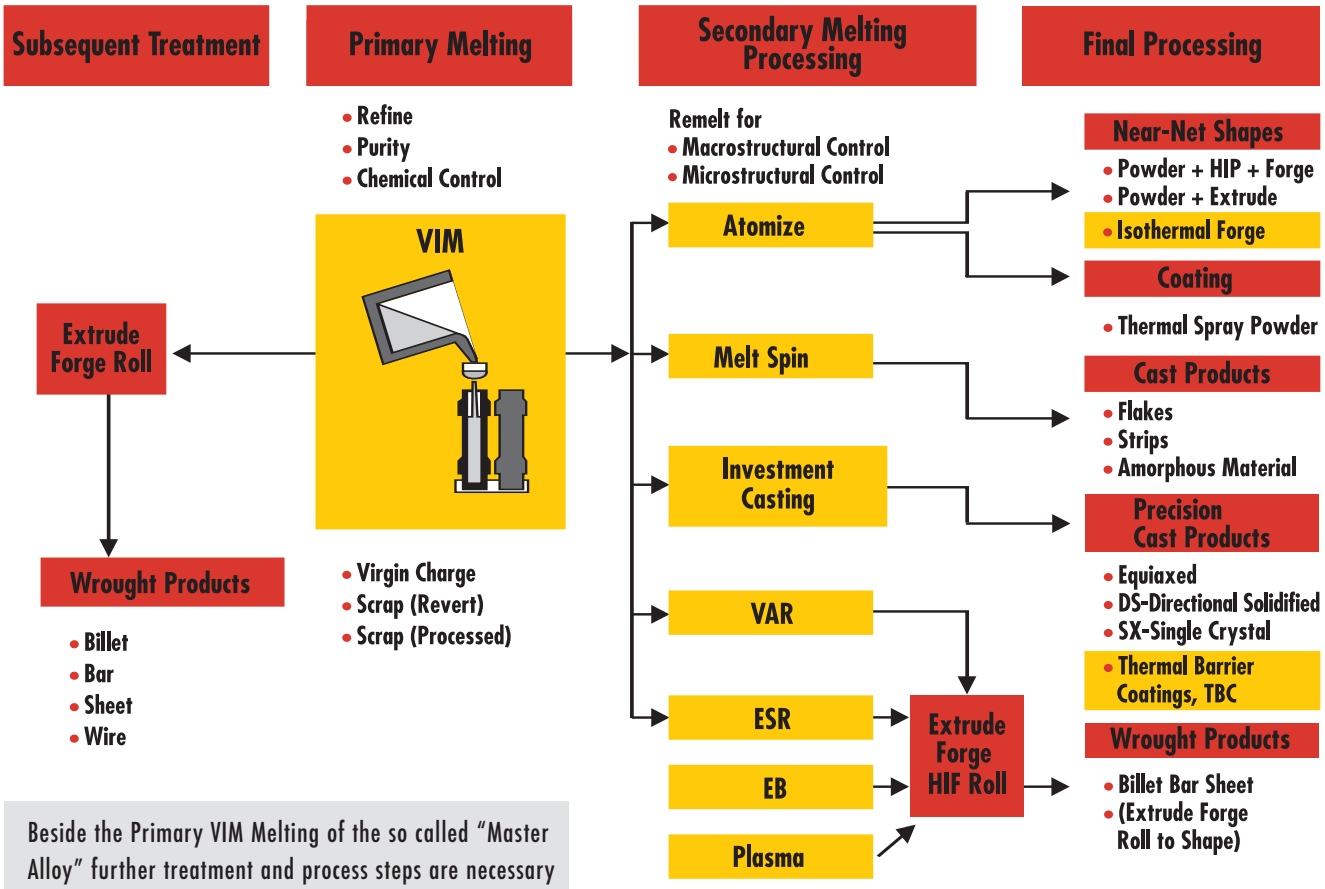


Melting/Refining

Casting

Indispensable for High Purity Metals

Current processing route for products cast from VIM furnaces



Beside the Primary VIM Melting of the so called "Master Alloy" further treatment and process steps are necessary to achieve the required physical, chemical and structural properties of the specific material.

ALD proprietary Technologies

Vacuum Induction Melting enables a precise adjustment of the alloy composition and melt homogenization of the "Master Alloy".

Bar Stock, Ingots, Electrodes

Final Products

ALD Vacuum Induction Melting and Casting:

VIM Systems – Tailored to Solve Customers' Needs

ALD specializes in developing and implementing system designs tailored to customer specific needs. From analyzing your needs to design, planning, engineering, construction, startup, we can do a customized job. Availabe for all VIM furnaces are:

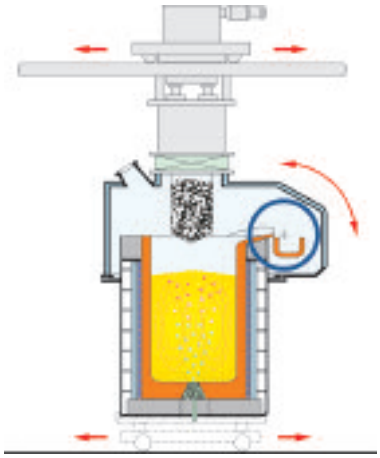
- Additional induction coils for different melt materials and crucible sizes
- Ingot/mold turntable or rectangular car for pouring into several molds
- Vacuum locks for charging
- Temperature measurement and sampling
- Inertgas purging
- Electromagnetic stirring
- Vacuum-pumping systems specially tailored for metallurgical use
- Melting power-supplies using medium frequency with modern transistor and thyristor converter

We do not only turn out standard products but solve process-engineering and metallurgical requirements.

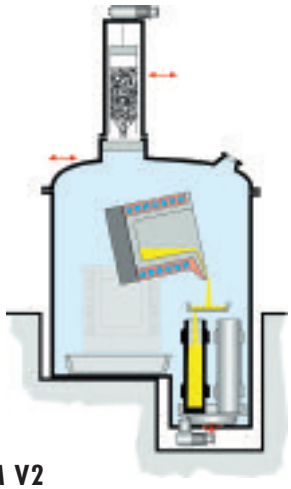
We offer a variety of basic versions:

- VIM-VIDP
  Special compact VIM furnace design
  - Ingot or continuous casting

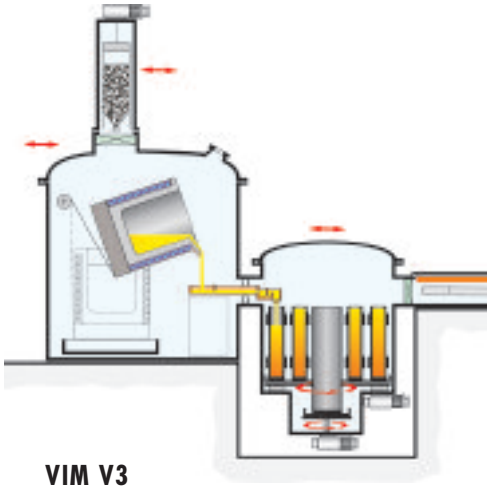
  VID, VIDEST (Destillation)
  VIDP - HCC (Horizontal continuous casting)
- VIM V2
  Single chamber
- VIM V3 thru V12
  Multiple chamber designs with modular construction



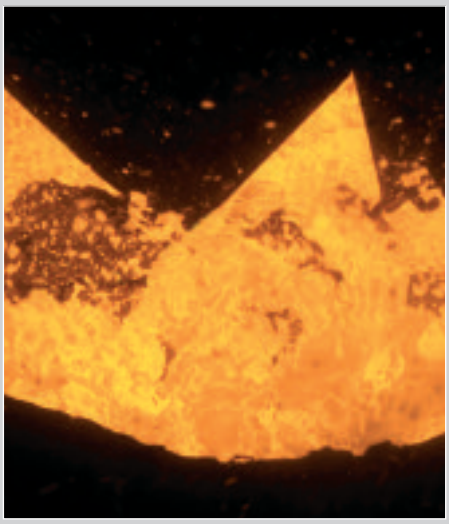
VIM-VIDP
Special compact VIM furnace design with tiltable melt chamber: various casting systems can be adapted.



VIM V2
Single-chamber system with turntable. Chamber is opened for loading and unloading after each melt.

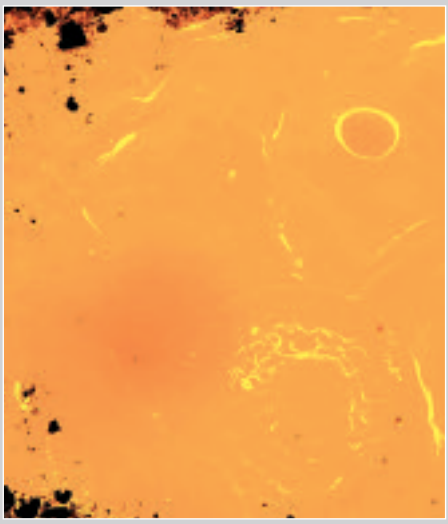


VIM V3
Two-chamber system with one turntable for short ingots and another for long ingots. Lock with heated launder.



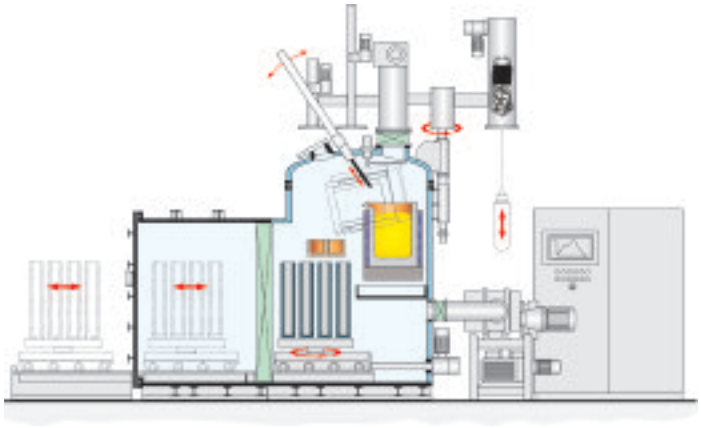
Charging

Melting

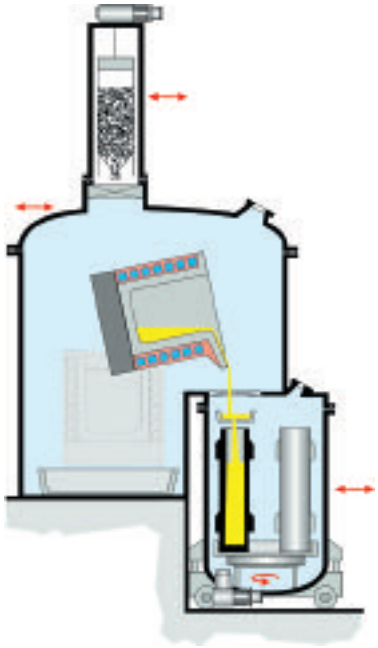


Refining/Degassing

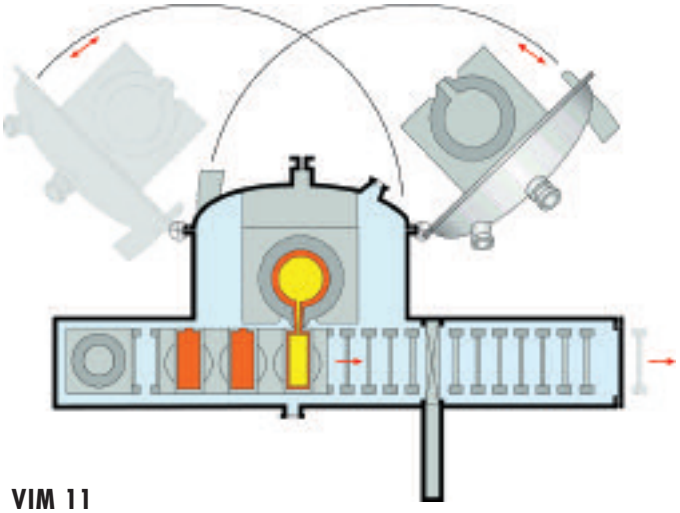
VIM Systems



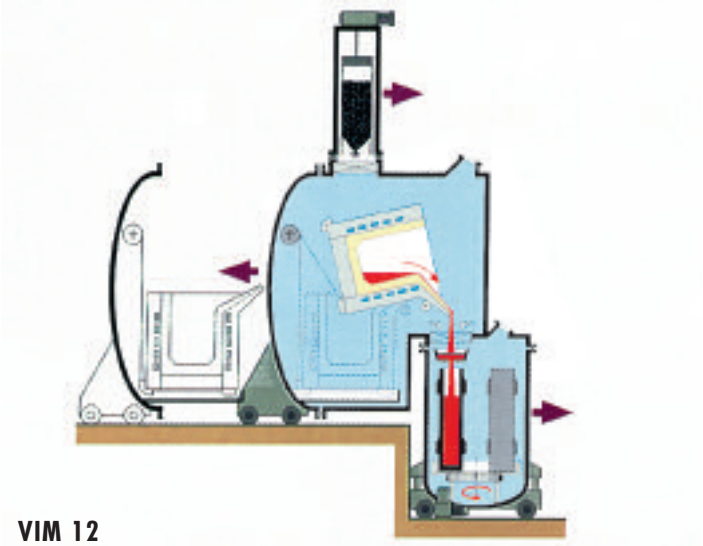
VIM V5
Two-chamber system with large mold chamber, separated by vacuum-lock gates with mold cars.



VIM V9
Multi-chamber system with a compact movable mold chamber and turntable. The two chambers are separated by a casting valve.

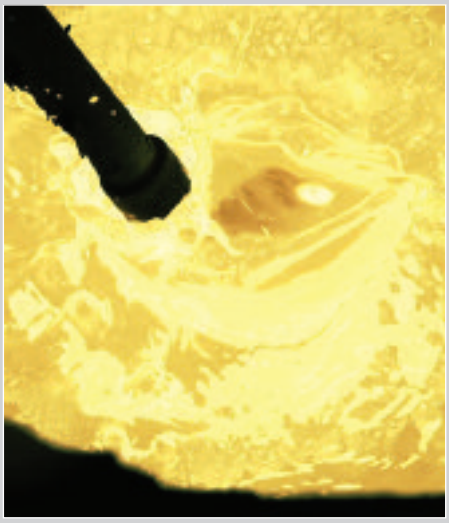


VIM 11
Two-chamber system with large mold chamber, separated by vacuum-lock gates with mold cars.

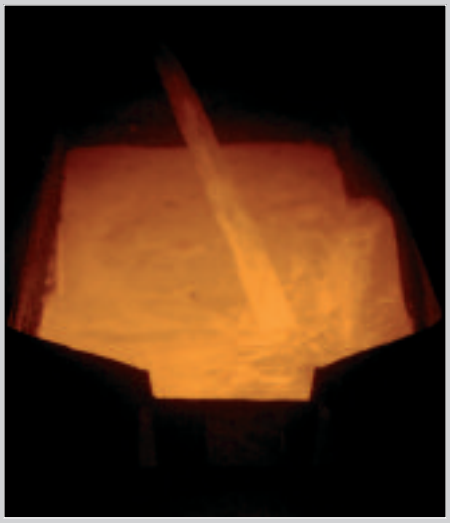


VIM 12
The VIM furnace one chamber system with horizontal melt chamber and moveable sidedoors for crucible coil service.

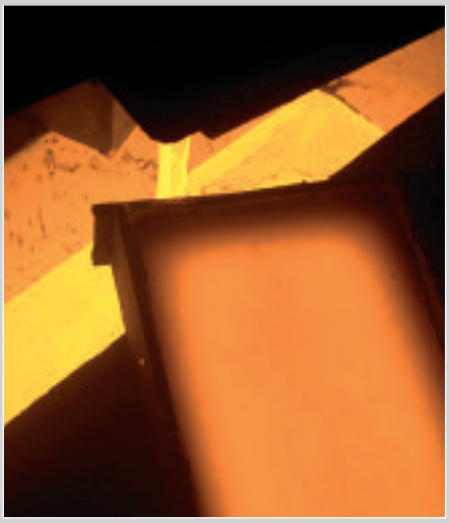
The VIM process: ALD solves process-engineering and metallurgical requirements.



Temperature measurement/Sampling

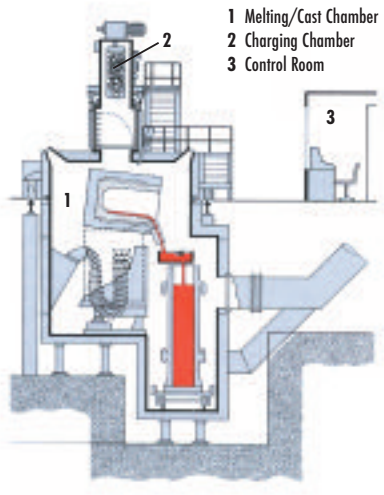


Tapping into launder/tundish



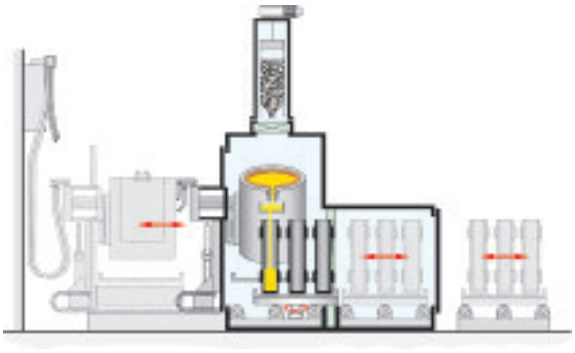
Casting into mold

ALD VIM Furnace References



25t VIM V5
Special Metals Corporation, Huntington, WV, USA

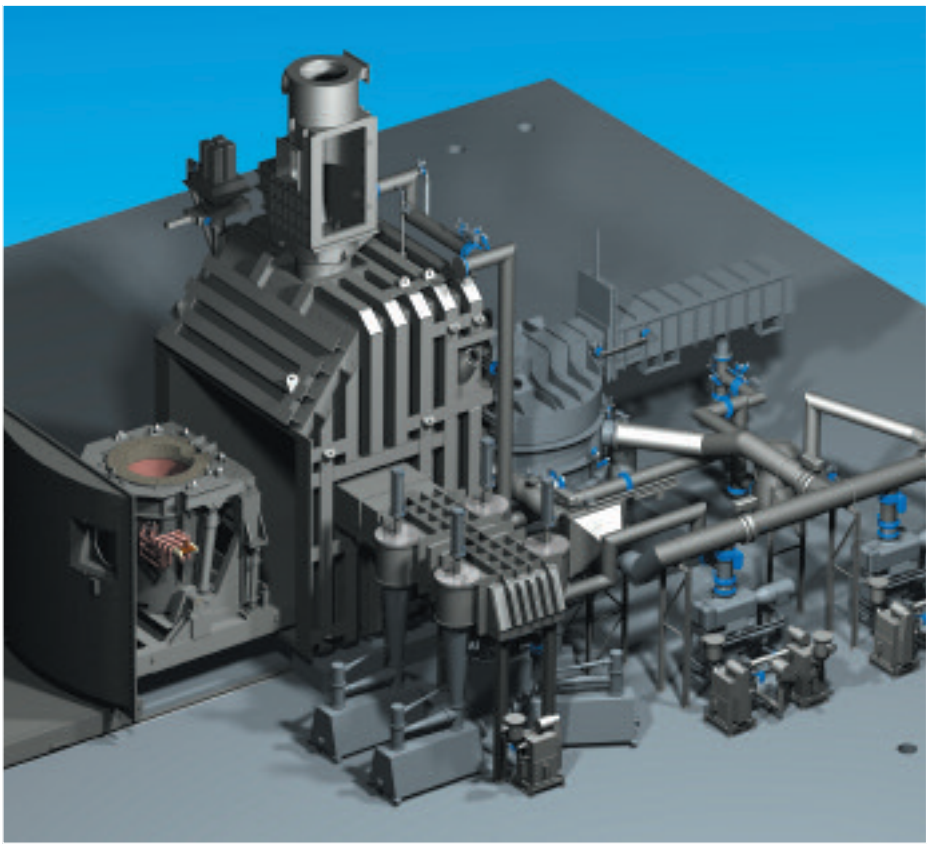
Melt/cast chamber with separate mold chamber for production of superalloys.



4/6 t VIM V6
Vacuumschmelze, Hanau, Germany

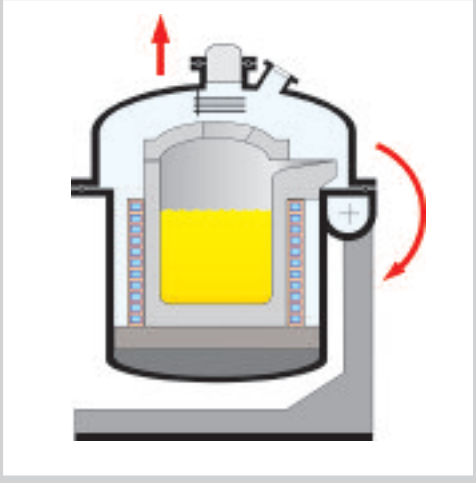
Production of Fe-Ni based electric/magnetic materials. Multi-chamber system with a compact movable mold chamber. Horizontal melting pot with a laterally movable door and furnace insert. Hydraulic tilting device and power cables are arranged outside the vacuum.

12 t VIM V6
Baoshan, Shanghai No. 5
and Dongbei, Fushun Special Steel



3 t VIM VID 300
Vacuumschmelze, Hanau, Germany

Tiltable compact furnace chamber.
Casting under atmosphere or inert gas pressure.

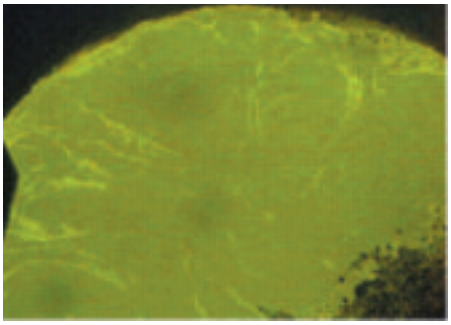


Essential Features: Cleanliness, Homogeni

Improvement in Oxide Cleanliness

Removal of non-metallic inclusions

- Soft rinsing of inert gas through the melt
- Agglomeration at the crucible
- Flotation and agglomeration in a transfer hot launder with slag barriers (dam and weirs)
- Additional ceramic filter – pore size 20-50 ppi



Electromagnetic stirring

Melt Homogenization, Melt Stirring

3-Phase, 50 Hz Electromagnetic Stirring

- Homogeneity
  Chemical Composition
  Melt Temperature
- Increased yield of adding volatile elements
- Shorter Degassing Time

Above: Pre-heated transfer launder with barriers and filters for removal of inclusions

Left: Transfer launder with dam and weirs

Process Reproducibility/Control

PC/PLC-Control and Automation

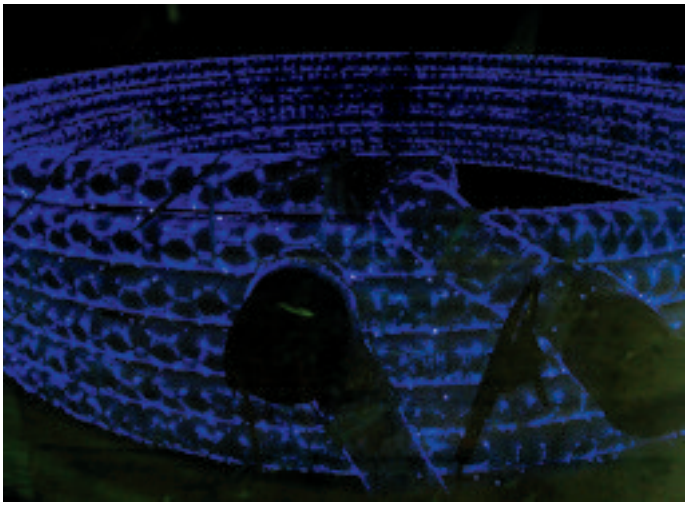
▼

Exact Process Control

- Melt Bath and Pouring Temperatures
- Vacuum Conditions
- Leak-up Rate Control
- Cooling Water Conditions
- Data Acquisition
- Maintenance Diagnostic System
- Energy Management
- Melt-Trend Analysis
- Pouring Weight

All relevant Process Steps are monitored via Video Cameras
Operation of the Process primarily from the Control Room

zation, Reproducibility, Preheating



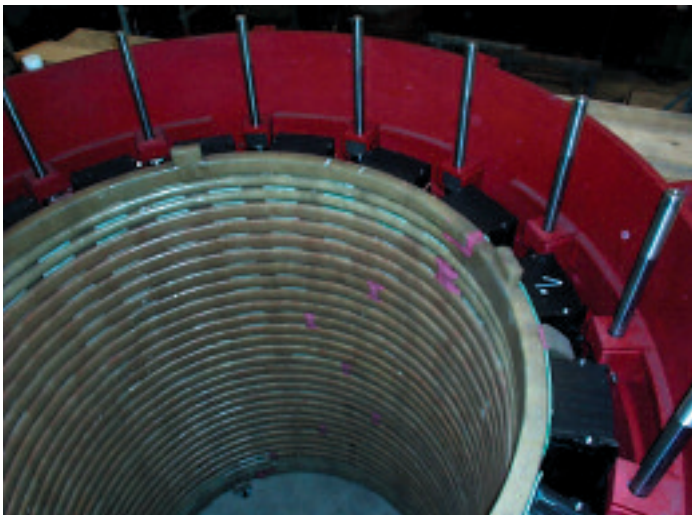
Corona test: special insulation test for vacuum applications

Proprietary Induction Coils for Vacuum Applications

- Manufactured inhouse
- Highly efficient and robust design
- Special vacuum insulation
- Extensive testing procedures

Highly customized Coil Design

- for different crucible sizes
  (prefired or rammed or bricked crucible)
- to different melt materials



Coil assembling

Inhouse manufacturing of customized induction coils

Vacuum preheating of a VIM-VIDP Crucible Furnace

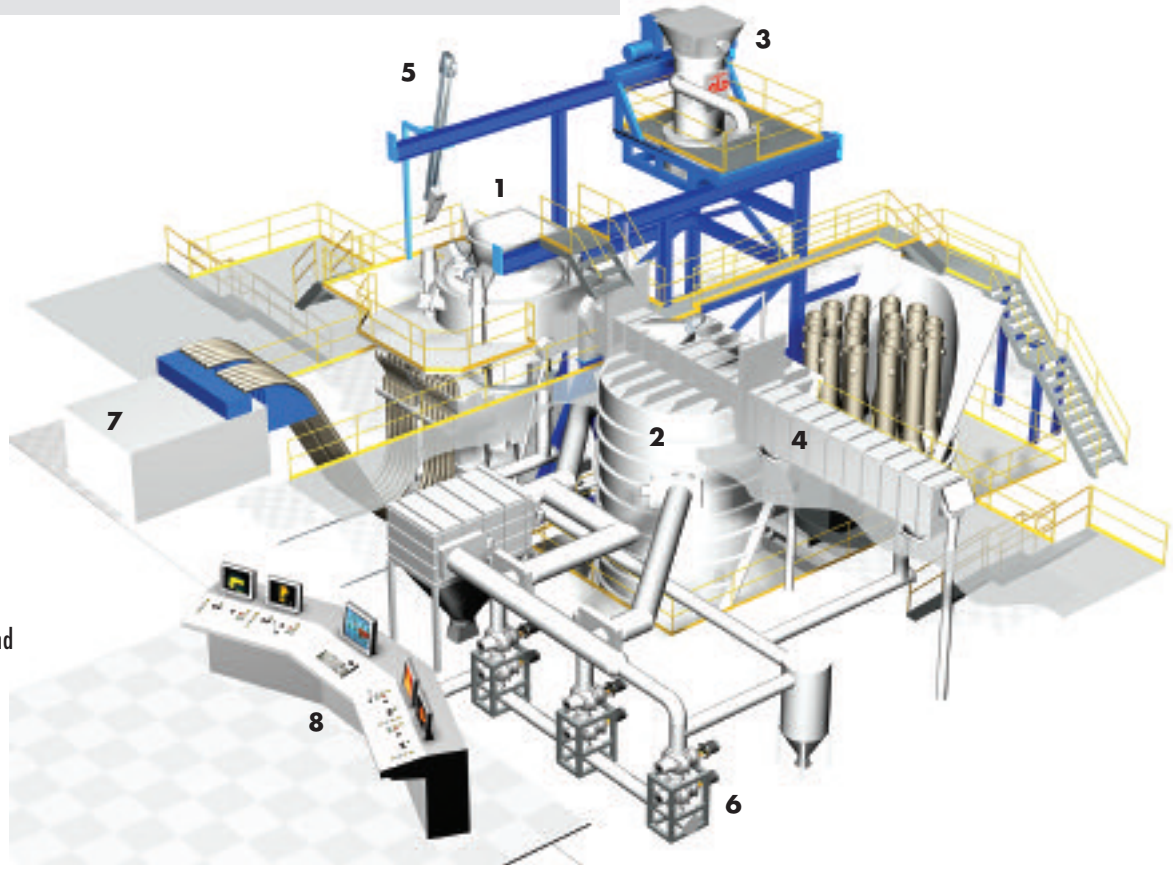
Process Control: The "State-of-the-Art" ensures highest degrees of reproducibility.

Process Automation – "State-of-the-Art" with Remote Operation and Data Logging

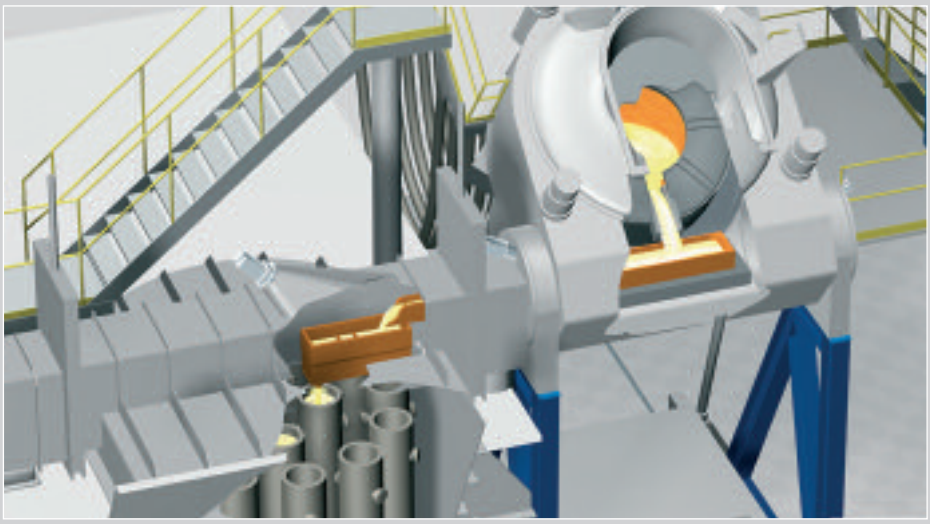
ALD VIM–VIDP Design

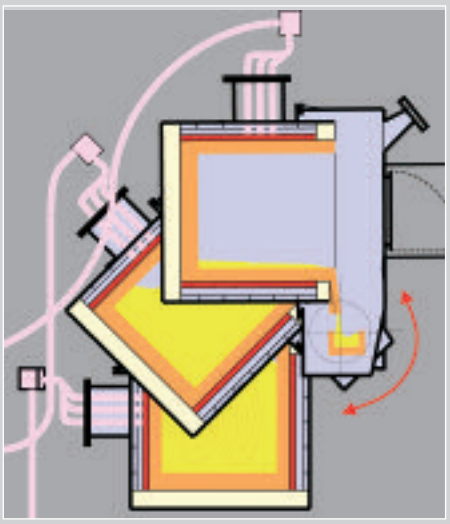
VIM-VIDP Advantages:

- Small Furnace Volume and lowest Desorption Rate (1:10 compared to chamber type)
- Small Vacuum Pumping System
- Fast Furnace Change < 1 hr between heats with hot crucible
- High Productivity
- High Flexibility
- Power Cables and Hydraulic Lines outside the melting chamber, no leakage risk



1 VIM-VIDP melting chamber
2 Mold chamber
3 Charging device
4 Launder chamber
5 Temperature measurement and sampling device
6 Vacuum system
7 Power supply
8 System control desk





Tiltable melting chamber with transfer launder and separate casting chamber

ALD VIM–VIDP References

16 t VIM-VIDP 2000
Böhler Edelstahl, Kapfenberg, Austria

20/30 t VIM-VIDP 3000
Thyssen Krupp VDM, Unna, Germany

2 t VIM-VIDP 400
Advanced Technology & Materials (AT & M)
Beijing, China

Technical Data

Characteristic	Units	VIM 100	VIM 200	VIM 400	VIM 800	VIM 1000	VIM 1400	VIM 2000	VIM 3000
Crucible size									
Capacity (based on Ni)	(metric tons)	1	2	4	6	8	12	24	30
Typical cycle times									
Ni-Co base alloy	(h)	3-4	3-4	4-5	6-8	6-8	6-8	6-8	8-10
Fe base alloys/special steels	(h)	2-5	2-5	3-4	3-6	3-6	3-6	3-6	6-8
Mold/Ingot size and combination		According to customer specification							
Operating pressure									
With mechanical pump set	(mbar)	10^{-1}-10^{-2}	10^{-1}-10^{-2}	10^{-1}-10^{-2}	10^{-1}-10^{-2}	10^{-1}-10^{-2}	10^{-1}-10^{-2}	10^{-1}-10^{-2}	10^{-1}-10^{-2}
With oil booster pump set	(mbar)	10^{-2}-10^{-3}	10^{-2}-10^{-3}	10^{-2}-10^{-3}	10^{-2}-10^{-3}	10^{-2}-10^{-3}	10^{-2}-10^{-3}	10^{-2}-10^{-3}	10^{-2}-10^{-3}
Recommanded Power Supply for Melting									
MF power at 600 V output	(kW)	530	750	1500	2000	2400	3000	4000	5000
Frequency	(KHz)	250 – 500							
Electr. connected Loads incl. Vacuum Pumping Unit	(kVA)	200	200	250	250	250	300	300	350
Line-voltage data		According customer mains							
Cooling Water									
Total consumption (Δt=10 °C)	($m^3 \times h^{-1}$)		approx. 80		approx. 120		approx. 200		approx. 250
Floor area									
Length (L) x Width (W)	L x W (m)		10 x 10		12 x 10		14 x 14		25 x 16
Height	(m)		8.5		9.5		10		12
Recommended									
Crane capacity	(metric tons)	15	15	20	30	30	50	60	70

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