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

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

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
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. Available 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 side doors for crucible coil service.

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**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, Homogenization**

**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

**Melt Homogenization, Melt Stirring**

3-Phase, 50 Hz Electromagnetic Stirring
- Homogeneity
- Chemical Composition
- Melt Temperature
- Increased yield of adding volatile elements
- Shorter Degassing Time

**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
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

Corona test: special insulation test for vacuum applications

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

### Crucible size
- Capacity (based on Ni) (metric tons)
  - 100 VIM: 1
  - 200 VIM: 2
  - 400 VIM: 4
  - 800 VIM: 6
  - 1000 VIM: 8
  - 1400 VIM: 12
  - 2000 VIM: 24
  - 3000 VIM: 30

### Typical cycle times
- Ni-Co base alloy (h)
  - 100 VIM: 3-4
  - 200 VIM: 3-4
  - 400 VIM: 4-5
  - 800 VIM: 6-8
  - 1000 VIM: 6-8
  - 1400 VIM: 6-8
  - 2000 VIM: 8-10

- Fe base alloys/special steels (h)
  - 100 VIM: 2-5
  - 200 VIM: 2-5
  - 400 VIM: 3-4
  - 800 VIM: 3-6
  - 1000 VIM: 3-6
  - 1400 VIM: 3-6
  - 2000 VIM: 6-8

### Mold/Ingot size and combination
- According to customer specification

### Operating pressure
- With mechanical pump set (mbar)
  - 100 VIM: 10\(^1\)-10\(^2\)
  - 200 VIM: 10\(^2\)-10\(^3\)
  - 400 VIM: 10\(^1\)-10\(^2\)
  - 800 VIM: 10\(^2\)-10\(^3\)
  - 1000 VIM: 10\(^1\)-10\(^2\)
  - 1400 VIM: 10\(^2\)-10\(^3\)
  - 2000 VIM: 10\(^1\)-10\(^2\)
  - 3000 VIM: 10\(^2\)-10\(^3\)

- With oil booster pump set (mbar)
  - 100 VIM: 10\(^2\)-10\(^3\)
  - 200 VIM: 10\(^3\)
  - 400 VIM: 10\(^2\)-10\(^3\)
  - 800 VIM: 10\(^3\)
  - 1000 VIM: 10\(^2\)-10\(^3\)
  - 1400 VIM: 10\(^3\)
  - 2000 VIM: 10\(^2\)-10\(^3\)
  - 3000 VIM: 10\(^3\)

### Recommended Power Supply for Melting
- MF power at 600 V output (kW)
  - 100 VIM: 530
  - 200 VIM: 750
  - 400 VIM: 1500
  - 800 VIM: 2000
  - 1000 VIM: 2400
  - 1400 VIM: 3000
  - 2000 VIM: 4000
  - 3000 VIM: 5000

- Frequency (KHz)
  - 100 VIM: 250 – 500
  - 200 VIM: 250
  - 400 VIM: 250
  - 800 VIM: 250
  - 1000 VIM: 250
  - 1400 VIM: 300
  - 2000 VIM: 300
  - 3000 VIM: 350

### Electr. connected Loads incl. Vacuum Pumping Unit (kVA)
- According to customer mains
  - 100 VIM: 200
  - 200 VIM: 200
  - 400 VIM: 250
  - 800 VIM: 250
  - 1000 VIM: 250
  - 1400 VIM: 300
  - 2000 VIM: 300
  - 3000 VIM: 350

### Cooling Water
- Total consumption (\(\Delta t=10 \, ^\circ\text{C}\)) (m\(^3\) x h\(^\text{-1}\))
  - 100 VIM: approx. 80
  - 200 VIM: approx. 120
  - 400 VIM: approx. 200
  - 800 VIM: approx. 250

### Floor area
- Length (L) x Width (W) (m)
  - 100 VIM: 10 x 10
  - 200 VIM: 12 x 10
  - 400 VIM: 14 x 10
  - 800 VIM: 16 x 10

- Height (m)
  - 100 VIM: 8.5
  - 200 VIM: 9.5
  - 400 VIM: 10
  - 800 VIM: 12

### Recommended Crane capacity (metric tons)
  - 100 VIM: 15
  - 200 VIM: 15
  - 400 VIM: 20
  - 800 VIM: 30
  - 1000 VIM: 30
  - 1400 VIM: 50
  - 2000 VIM: 60
  - 3000 VIM: 70

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