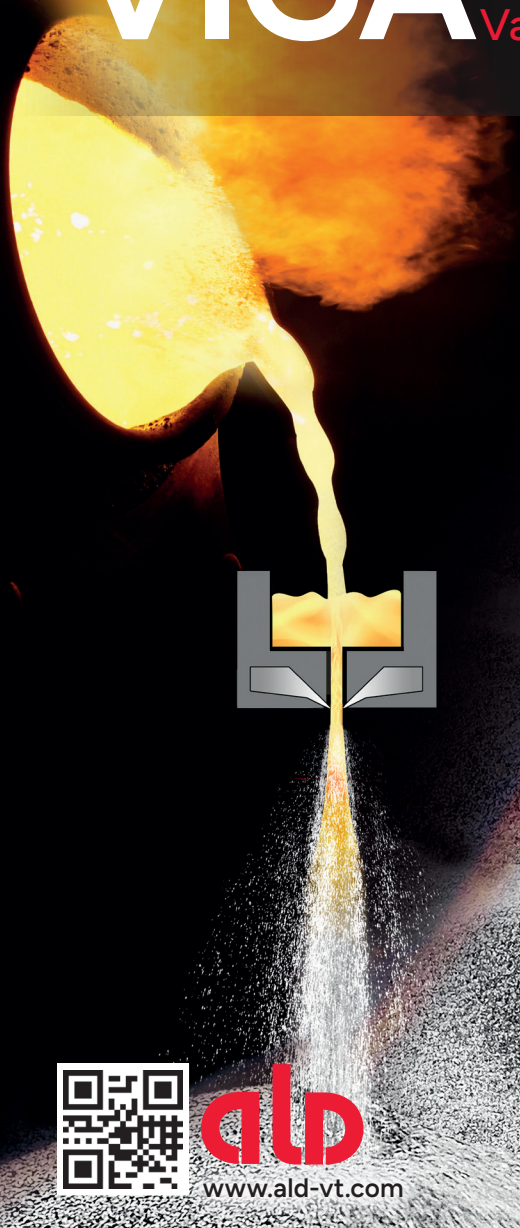


ALD Vacuum Technologies

High Tech is our Business

VIGA METAL POWDER PRODUCTION

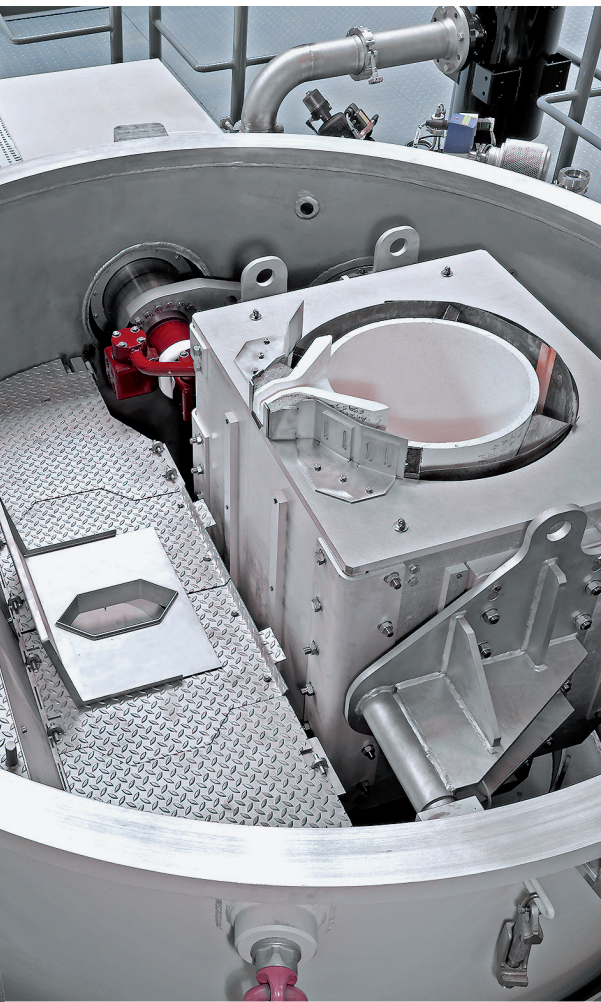
Vacuum Induction Melting Inert Gas Atomization



ald
www.ald-vt.com



POWDER PRODUCTION



Vacuum Induction Melting Inert Gas Atomization

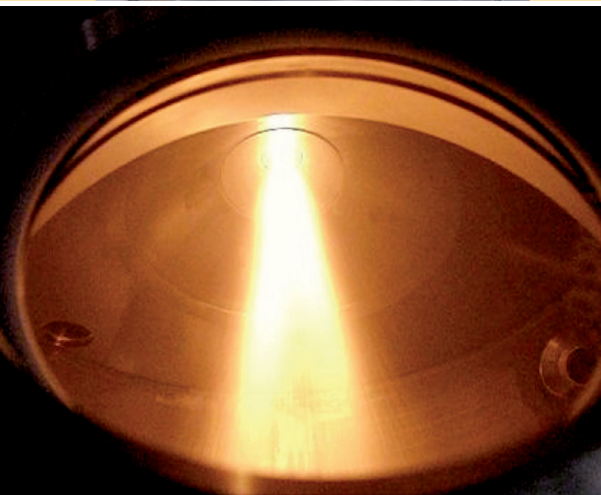
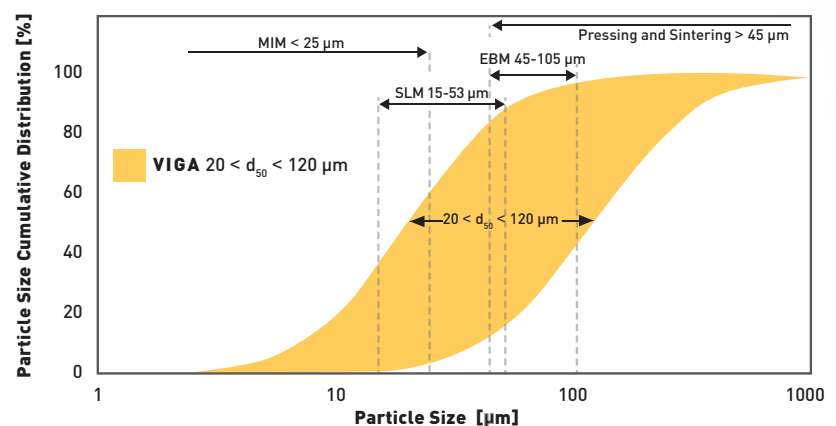
PROCESS CHARACTERISTICS & SEQUENCE

- ▶ Leading process for production of high-quality Fe / Co / Ni / Cr / Cu and other metal alloy powders with superb characteristics
- ▶ Excellent product quality repeatability due to precise control of all critical process parameters
- ▶ Melting of metallic raw materials under vacuum or inert conditions
- ▶ Controlled delivery of molten metal by top or bottom pouring via tundish and / or orifice towards close-coupled gas nozzle
- ▶ Atomization of metal stream into spray of micro-droplets by high-pressure inert gas jet
- ▶ Solidification of droplets and forming of powder particles in atomization tower
- ▶ Powder transport and collection under inert conditions

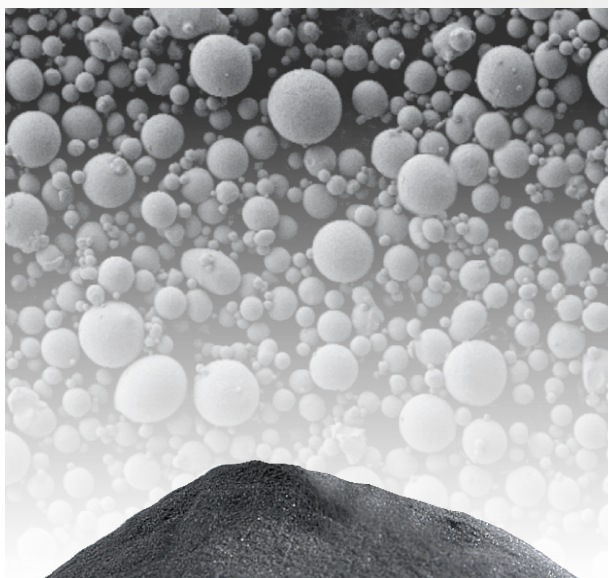
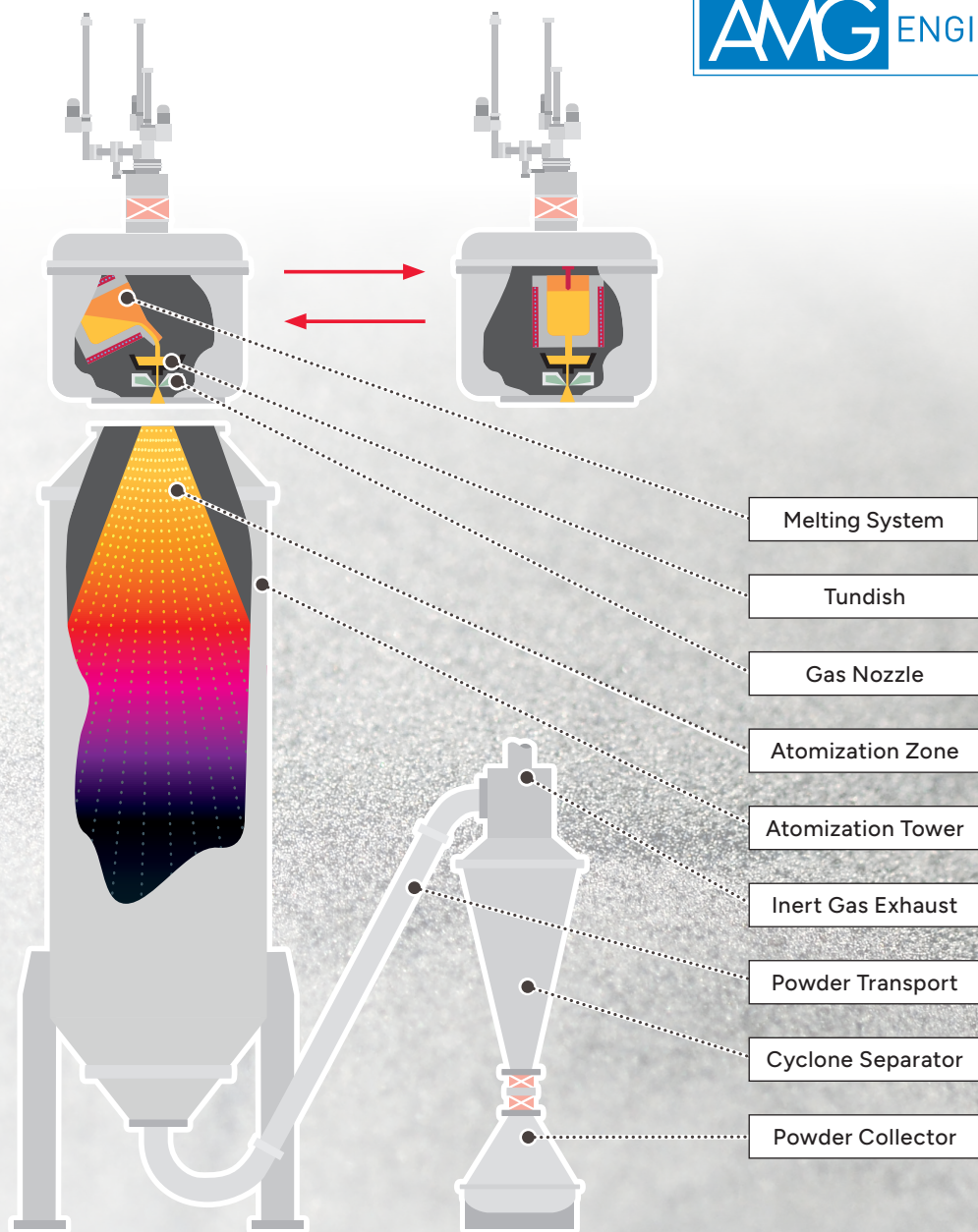


Powder Characteristics

PARTICLE SIZE

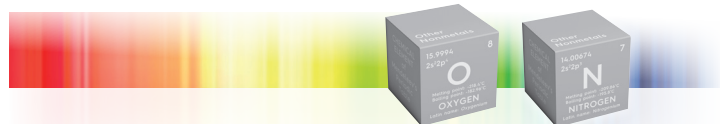


- ▶ Log normal Gaussian particle size distribution (PSD)
- ▶ d_{50} value of PSD adjustable between 20 – 120 μm for a variety of alloys
- ▶ PSD width / standard deviation $S = d_{84}/d_{50} = d_{50}/d_{16}$ ranges from 2.0 to 2.5
- ▶ d_{50} values less than 20 μm achievable for low melting alloys



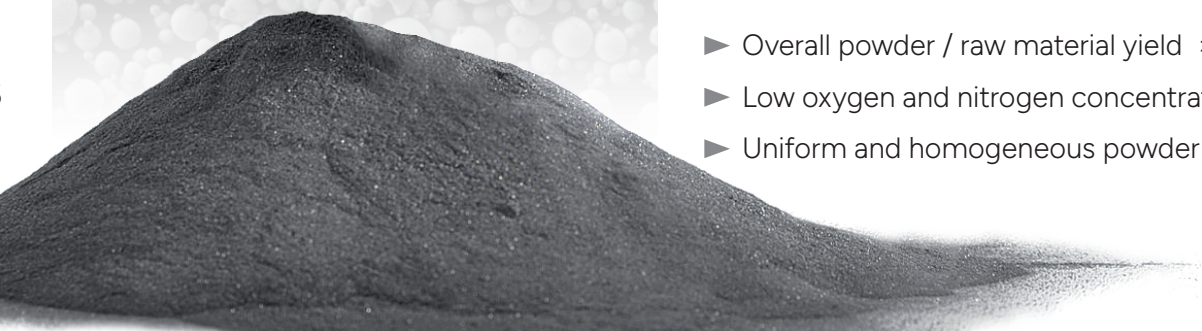
MORPHOLOGY

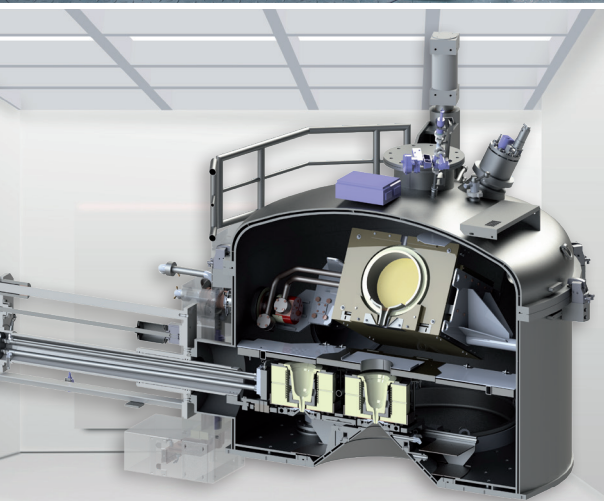
- Spherical morphology
- High flowability and tap density



OTHER CHARACTERISTICS

- Overall powder / raw material yield > 95 %
- Low oxygen and nitrogen concentrations
- Uniform and homogeneous powder chemistry





World Class VIGA Systems from the Market and Technology Leader for Inert Gas Atomizers

ALD's VIGA MODEL SERIES & DESIGN FEATURES

- ▶ Lab-scale systems with 5 – 15 kg batch size up to large-scale powder production plants with 2000 kg batch size
- ▶ Productivity of 20 t up to 2000 t per annum
- ▶ Double door melting chamber (large systems) with individual vacuum induction melting station for each door
- ▶ Quick-change induction furnace boxes with different capacities available for one specific VIGA model
- ▶ Bottom (small systems) and top pouring (medium and large systems)
- ▶ Redundant double tundish system to minimize risk of material losses and equipment downtime
- ▶ Suitable sized atomization tower, ascending powder conveying tube, cyclone and additional dust filter for high-efficient powder transport and collection

TYPICAL PERFORMANCE DATA FOR DIFFERENT VIGA SIZES

		VIGA2B	VIGA5	VIGA8
Overall Height	[m]	4.7	7.0	9.5
Typical Footprint	[m * m]	5.0 * 6.0	6.0 * 7.0	6.5 * 7.5
Max. Melt Volume	[l]	2	5	8
Max. Batch Weight*	[kg]	15	40	60
Typical Metal Flow Rate	[kg/min]	5-15	10-20	10-20
Typical Atomization Gas Flow Rate	[m³/h]	1000-1500	1200-2100	1200-2100
Typical Atomization Time	[min]	2	3	5
Typical Total Cycle Time	[h]	2.0	2.5	3.0
Max. Annual Powder Production**	[mt/yr]	45	100	125
Typical D ₅₀ Value Range	[µm]	20 - 120	20 - 120	20 - 120

*Based on IN718, based on **24/7 operation and 260 days of production / yr



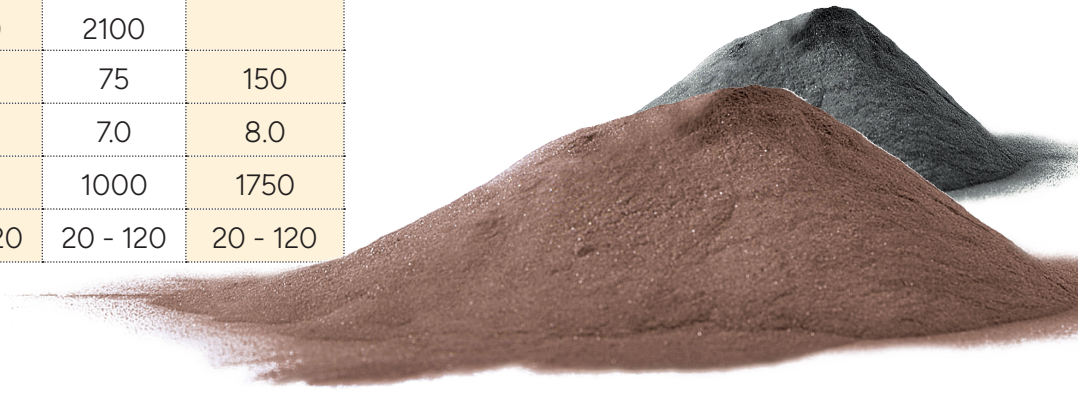
Excellent references
with leading powder
producers worldwide



VIGA16	VIGA35	VIGA45	VIGA70	VIGA150	VIGA300
10.0	11.5	12.5	13.5	16.0	18.0
7.0 * 8.0	8.0 * 9.0	8.0 * 9.0	10.0 * 12.0	13.0 * 20.0	21.0 * 26.0
16	35	45	70	150	300
120	260	350	525	1125	2250
10-20	10-20	10-20	10-20	10-20	10-20
1200-2100	1200-2100	1200-2100	1200-2100	1200-2100	1200-2100
10	22	29	44	75	150
3.5	4.0	4.5	5.5	7.0	8.0
210	400	480	600	1000	1750
20 - 120	20 - 120	20 - 120	20 - 120	20 - 120	20 - 120



More than 100 successfully
commissioned inert gas
atomization systems



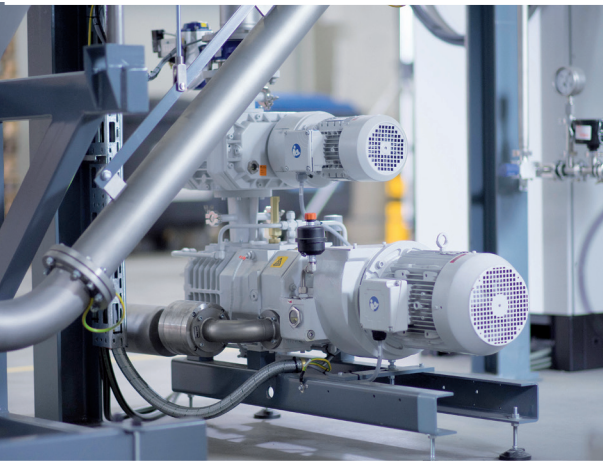


POWDER PRODUCTION

New Design Features & Specialized Furnace Concepts

POWER FOR POWDER - YOUR KEY TO SUCCESS

- ▶ Engineering and manufacturing of customer-specific VIGA type inert gas atomizers
- ▶ New design features Gas Recirculation and Hot Gas Atomization
- ▶ Specialized furnace concepts such as
 - VIGA2B-EIGA integrated inert gas atomization system
 - IGA systems
 - Spray forming systems



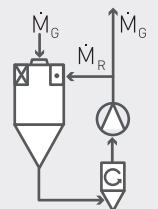
Antisatellite system VIGA35

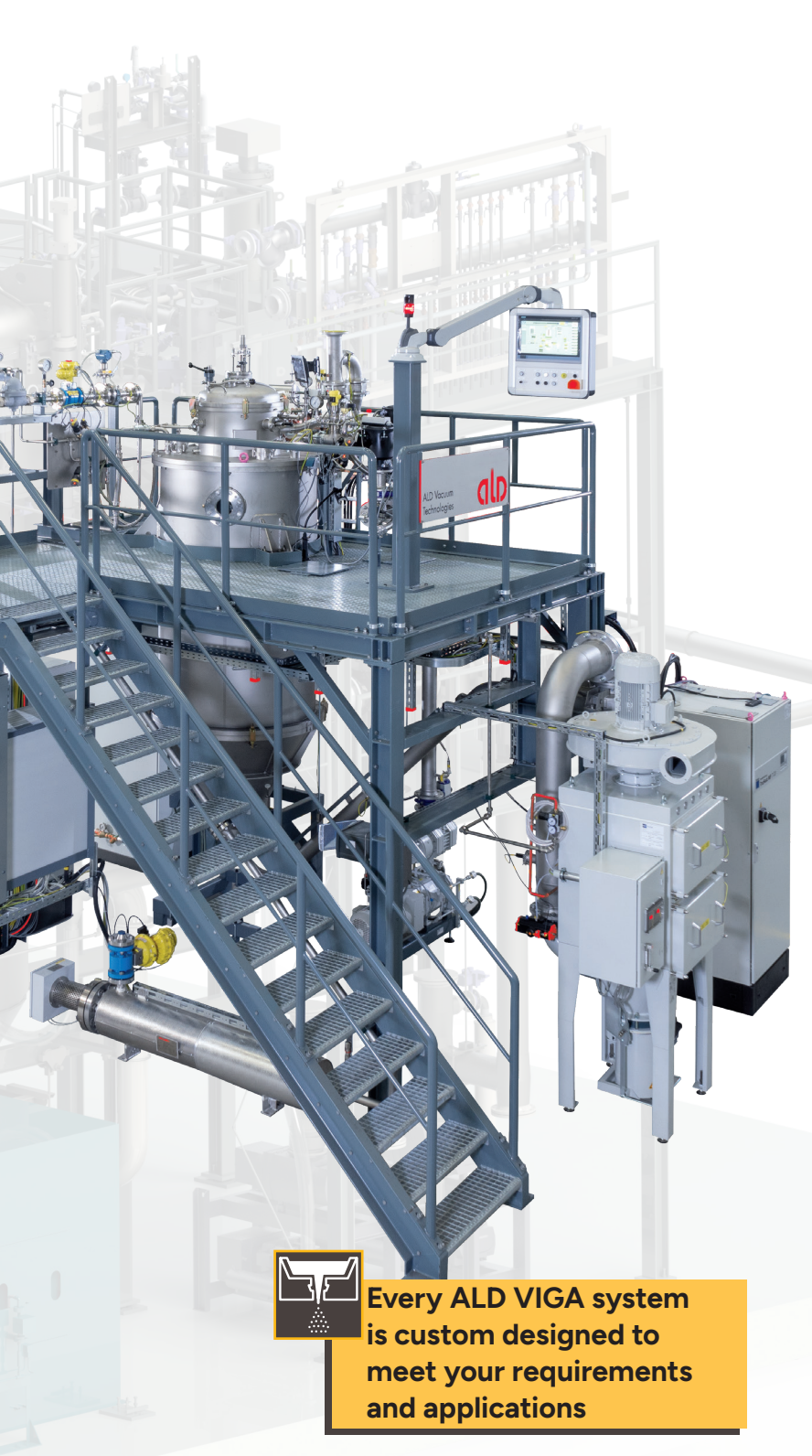


NEW FEATURE

Gas Recirculation

- ▶ Recirculation of inert gas and supply into atomization tower beside fresh atomization gas
- ▶ Minimization of powder particle collisions and satellite formation
- ▶ Substantial improvement of overall powder morphology





Every ALD VIGA system is custom designed to meet your requirements and applications



NEW FEATURE

Hot Gas Atomization

- Atomization gas pre-heating up to 400 °C
- Reduction of atomization gas consumption
- Optimization of powder yield for specific applications



ALD VIGA Systems – World Class Equipment to produce your metal-powder feedstock for a bright world of different processes & applications.

Powder Applications & End Markets

► POWDER PROCESSING

- MIM
- Plasma Spraying
- SLM / EBM 3D-Printing & other AM processes
- Pressing and Sintering

► ADDITIVE MANUFACTURED PARTS

► AVIATION

P/M rotor discs, turbine blades & structural components

► AUTOMOTIVE

Near net shape MIM components

► POWER ENGINEERING

Wear and oxidation protection coatings, MCrAlY plasma spray coatings

► MEDICAL TECHNOLOGY

Co-Cr based dental and body implants

► ELECTRONICS & CHEMICAL INDUSTRY

Sputtering processes and coatings for chemical reaction vessels

► PRECIOUS METAL INDUSTRY

Jewelry and Catalysts

► RESEARCH & DEVELOPMENT





www.ald-vt.com



ALD – A Leading Supplier for Advanced Vacuum Furnaces

As one of the leading suppliers of vacuum plants and process technology we supply the entire vacuum metallurgy and vacuum heat treatment sector with our high-tech products and processes. ALD offers individual solutions for the best economic performance. We offer worldwide care and maintenance service of our high-quality plants for their entire lifecycle. Each newly delivered ALD plant meets the latest digital standards and is characterized by a particularly high level of environmental compatibility.

150+ YEARS EXPERIENCE – A Young Company with History

ALD Vacuum Technologies

Otto-von-Guericke Platz 1
63457 Hanau, Germany
Phone: +49 6181 307-0
Fax: +49 6181 307-3290
E-Mail: info@ald-vt.com

**ALD Vacuum Technologies
North America, Inc. (USA)**
info@ald-usa.com
Phone: +1 860 386 7227

ALD France
info@ald-france.eu
Phone: +33 4 76 33 64 40

**ALD Vacuum Technologies
(Thailand) Co. Ltd.**
SouthEastAsia@ald-vt.com
Phone: +66 2 550 7880

**OOO ALD Vacuum
Technologies (Russia)**
www.ald-russia.ru
info@ald-russia.ru
Phone: +7 495 78767-34

**ALD Vacuum Technologies
India Pvt. Ltd.**
www.aldvt-india.com
sales@aldvt-india.com
Phone: +91 91520 03246/47

**ALD-C&K Vacuum Technologies
(Suzhou) Co., Ltd. (PR China)**
www.ald-cnkn.com
info@ald-cnkn.com
Phone: +86 512 6385 8833

**ALD Thermo Technologies
Far East Co. Ltd. (Japan)**
In charge of: Japan,
South Korea, Taiwan
infoFE@ald-vt.de
Phone: +81 3 5961 3017