

Alloys for the
**Aerospace
Industry**



Tough demands are our business

During the past 85 years, VDM Metals has developed into a world market leader for high-performing metallic materials covering the widest product and service portfolio in the industry. The quality of our products and services is based on our integrated production chain in Germany and the United States and a sales network that spans the globe servicing the most demanding industries backed by a strong R&D and Application Engineering force.

VDM Metals produces high-performance alloys for use in extreme conditions – high temperatures, corrosive atmospheres, soaring heights and deep underground. Our materials are made to last, resisting heavy mechanical, thermal and chemical stresses, sometimes all three simultaneously. In many key technologies, alloys from VDM Metals are indispensable for the industrial-scale implementation and safe control of mission-critical processes in hot or corrosive environments.

Strategic investments, mergers and acquisitions have made the company one of the world leaders in the production of nickel and cobalt alloys, zirconium and special stainless steels. Our production sites can draw on extensive metallurgical know-how and long standing experience in the production of long and flat products in aerospace grade materials.

Focus on safety and reliability

In aerospace engineering, safety and reliability are always the top priorities. Vibrations, tremendous temperature differences and mechanical loads place enormous demands on all components.

VDM Metals performs extensive test series on each single product according to the respective customer specifications which define physical and mechanical properties as well as corrosion behavior, thus contributing to safe and reliable aircraft operations.

Certified by various manufacturers

VDM Metals' nickel products are certified by various aero engine and components manufacturers. As a matter of course, our quality assurance system is in compliance with the relevant international standards.

VDM materials are delivered as rod and bar, forgings, plate and sheet, strip, wire or welding consumables. Our processing plants and machinery are tailored to specific production requirements and local conditions. Our integrated manufacturing chain means that all major production steps are in our own hands – a vital prerequisite for a robust and stable manufacturing process with fixed practices.

We are where you need us to be

A globally operating sales organization, working in close cooperation with strategically situated service centers, ensures optimum customer proximity and a significant footprint in all key regions and markets.

The result of our efforts: efficient processes as well as maximum purity, homogeneity, reproducibility and optimum further processing characteristics of our products. Thus, our offering is nothing less than premium materials in any form needed as well as first class services, available anywhere in the world, right on time.

Committed to quality

As a company that produces and supplies high performing alloys, VDM Metals is highly committed to ensure that its products, processes and management systems are fully certified and comply with international standards. In numerous certification projects we have proven that we are able to implement new specifications quickly and reliably and gain the respective approvals.

Quality system approvals

- General Electric Aircraft Engines
- MT Aerospace
- SPS
- Pratt & Whitney LCS Approval
- DIN EN ISO 9001
- Nadcap (Mechanical Test Laboratory & Heat Treatment) + NDT
- EN/AS 9100
- GE S-400
- GE S-1000
- RR SABRe 9000
- Snecma Laboratory Approval
- Böhler Schmiedetechnik GmbH

Customer approvals

- AHG
- Airbus
- Boeing Rocketdyne
- Carlton Forge
- Exameca
- GE Aviation
- McDonnell Douglas
- McWilliams Forge
- Leistritz Turbinenkomponenten
- MTU Aero Engines
- Northrop Grumman
- NPO Saturn
- Pratt & Whitney
- Rolls-Royce
- Ruspolymer
- Safran Aero Engines (Snecma)
- Safran Helicopters Engines

Nothing is going to fly without nickel



Nickel alloys are among the toughest structural materials known. One classical application field is the use in turbine blades. Due to their strength and corrosion resistance, nickel alloys are furthermore used for various fuselage applica-

tions – e. g. structural parts and fasteners. Even in composite mold tooling, our alloys are used to take advantage of their low thermal expansion features.

Alloys

Nickel, iron & cobalt-based alloys

Nickel alloys (age hardenable)

VDM Metals designation	UNS	DIN EN	Specifications available on request	Product form						
				Billet	Bar	Shapes	Wire	Plate	Sheet	Strip
VDM® Alloy C-263	N07263	2.4650		+	+	+	•	•	•	•
René 41	N07041	2.4973		+	+	+				
Waspaloy*	N07001	2.4654		+	+	+				
VDM® Alloy X-750	N07750	2.4669		+	+	+				
VDM® Alloy 80A	N07080	2.4952		• +	• +	+				
VDM® Alloy 706	–	–		+	+	+				
VDM® Alloy 718	N07718	2.4668		• +	• +	+		•	•	•
VDM® Alloy 722	N07722	–		+	+	+				
VDM® Alloy 901	N09901	2.4662		+	+	+				
VDM® Alloy 903	N19903	–		+	+	+				

* Waspaloy is a trademark of United Technologies Corp.

Nickel alloys (non-hardenable)

VDM Metals designation	UNS	DIN EN	Specifications available on request	Product form						
				Billet	Bar	Shapes	Wire	Plate	Sheet	Strip
VDM® Alloy 400	N04400	2.4360		• +	• +	+	•	•	•	•
VDM® Alloy 600	N06600	2.4816		• +	• +	+	•	•	•	•
VDM® Alloy 601	N06601	2.4851		• +	• +	+	•	•	•	•
VDM® Alloy 617	N06617	2.4663		• +	• +	+	•	•	•	•
VDM® Alloy 625	N06625	2.4856		• +	• +	+	•	•	•	•
VDM® Alloy 75	N06075	2.4951		• +	• +	+	•	•	•	•

Nickel alloys (non-hardenable)

VDM Metals designation	UNS	DIN EN	Specifications available on request	Product form						
				Billet	Bar	Shapes	Wire	Plate	Sheet	Strip
VDM Alloy N	N10003	–		+	+	+				
VDM Alloy S	N06635	–		+	+	+				
VDM Alloy W	N10004	–				+				
VDM Alloy X	N06002	2.4665		+	+	+	•	•	•	•

Cobalt, chromium, nickel alloys

VDM Metals designation	UNS	DIN EN	Specifications available on request	Product form						
				Billet	Bar	Shapes	Wire	Plate	Sheet	Strip
VDM® Alloy 188	R30188	2.4683		+	+	+	•	•	•	•
VDM® Alloy L-605 / 25	R30605	2.4964		+	+	+	•	•	•	
VDM® Alloy N-155	R30155	–		+	+	+				
VDM® Alloy 35 N	R30035	–		+	+	+				

Austenitic iron-base alloys (age hardenable)

VDM Metals designation	UNS	DIN EN	Specifications available on request	Product form						
				Billet	Bar	Shapes	Wire	Plate	Sheet	Strip
VDM® Alloy A-286	S66286	1.4980		+	+	+				•

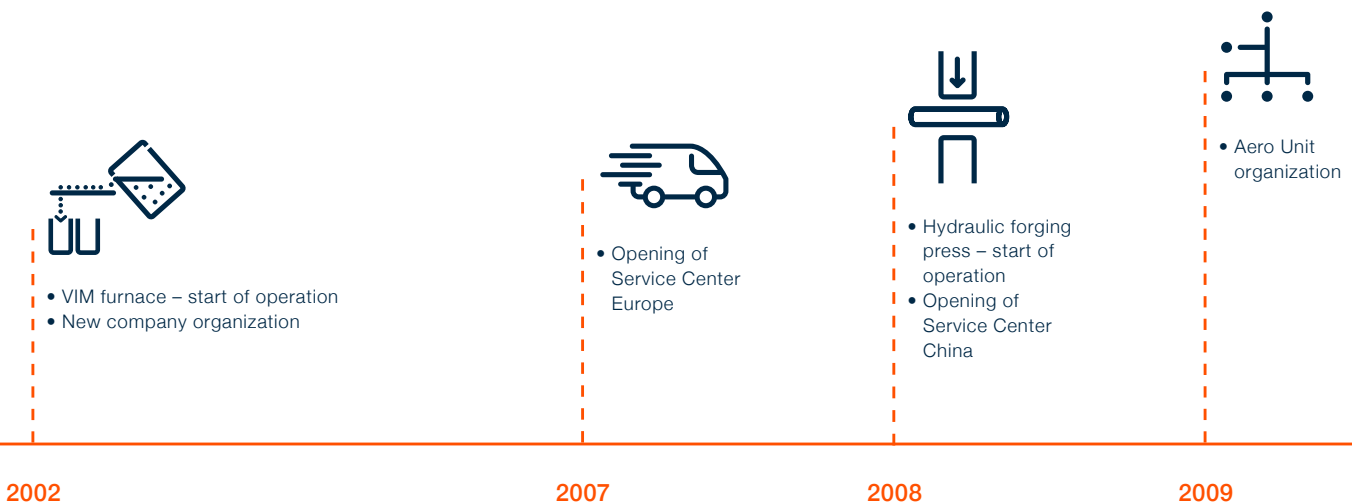
Nickel, iron and nickel, iron, cobalt alloy

VDM Metals designation	UNS	DIN EN	Specifications available on request	Product form						
				Billet	Bar	Shapes	Wire	Plate	Sheet	Strip
VDM® Alloy GSA	K94610	1.3981		• +	• +	+	•	•	•	•
VDM® Alloy Ni 36	K93603	1.3912		•	•		•	•	•	•

(VDM® Alloy Ni 33: Alloy for Resin Transfer Mould available on request.)

Investments in equipment and capabilities

Aerospace projects are characterized by high standards in terms of safety and reliability. Our customers expect professional partners with know-how and expertise. For several years, VDM Metals has pursued an extensive investment program geared towards modernizing and expanding its production facilities so as to maintain its leading position in the high performance alloys market while stepping up its activities in the aerospace engineering sector.



Our objectives are to meet our customers' requirements, be able to carry out every step in the production chain in-house, respond flexibly to customer needs and guarantee maximum delivery reliability. Our modern and extremely versatile range of facilities means that VDM Metals is optimally equipped to keep pace with present and future market demands and challenges. According to the philosophy of lean manufacturing, best practices and a robust production process, all our equipment features state-of-the-art process data acquisition for maximum productivity and reproducible product quality.

Melting and remelting

For the production of nickel alloys VDM Metals uses the technology of vacuum induction melting (VIM). Alternatively, materials are melted in an electric arc furnace and then subjected to vacuum treatment. In this case, a ladle furnace is available for secondary metallurgical treatment. Casting takes place in a vertical continuous caster or by ingot casting. The homogeneity and purity of VDM Metals' materials can be enhanced by electroslag (ESR) or vacuum arc remelting (VAR). With the combination of VIM/ESR/VAR, we are able to produce triple melted premium grade material such as VDM® Alloy 718.

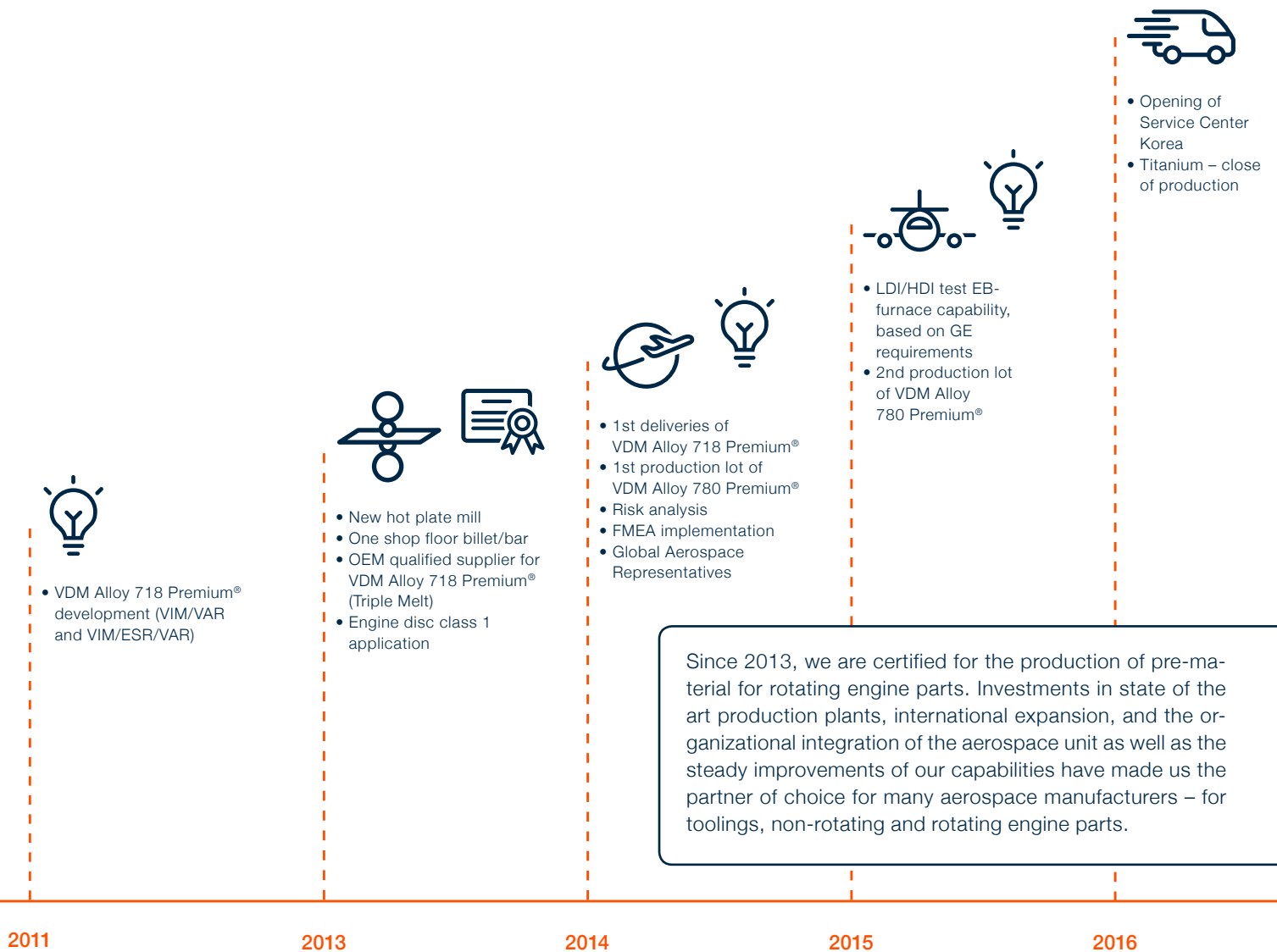
The cast and/or remelted slabs and ingots serve VDM Metals as starting material for the production of forgings, rods, bars, billets and shapes, sheets and plates, strips and wires. The production capacities and the capabilities at VDM Metals have been significantly expanded in recent years. Our investments, particularly those in our new bar production and our forging line at Unna, Germany, are the basis for solid growth, both for our customers and for ourselves, through ensured high product quality and stable production processes.

Forgings

VDM Metals' 45 MN forging press uses two rail-bound manipulators and receives its feedstock from certified heating and reheating furnaces. Following precisely specified procedures, bars, billets and other semi-finished products are produced.

Rods, bars, billets and shapes

For the production of forged bars in nickel with a diameter of more than 4.72 in (120 mm) and semi-finished products, state-of-the-art turning lathes and peeling machines are available. The production of hot-rolled and forged bars with a diameter of less than 4.72 in (120 mm) is performed with modern peeling



and grinding machines. A 60-ton drawing bench is available for the manufacture of cold-drawn precision bars.

Our U.S. bar products are rolled on a Birdsboro Single Stand mill capable of accepting ingot and/or billet up to 16 in (406 mm) diameter. It has the capability to produce 2 in (51 mm), 3 in (76 mm) and 4 in (102 mm) round cornered square (RCS) billet, and slabs up to 17 in (432 mm) wide. This mill can also produce flats and narrow plates.

Alternatively, the hot rolling of round bar, flat bar, and specialty shapes is performed on either a 14 in (355 mm) or a 10 in (254 mm) hand mill. As a matter of course, VDM Metals' finishing plants are equipped with heat treatment furnaces, pickling, shot blasting and cutting units in order to meet customer needs.

Sheet and plate

Sheets and plates in thicknesses of 0.12 to 3.93 in (3 to 100 mm) with a maximum length of 472 in (12,000 mm) are hot rolled on a four-high mill, before finishing steps such as annealing, shot blasting, pickling, grinding and cutting take

place. VDM Metals operates a Sendzimir reversing mill that can process hot-rolled sheets to individual cold-rolled sheets in widths of up to 98.42 in (2,500 mm).

Strip

Strip is cold rolled on four-high and Sendzimir mills. Foil can be rolled down to a thickness of 0.001 in (0.025 mm) on a special 20-high mill. Annealing, leveling and cutting equipment is available for finishing operations to meet customer specifications.

Wire and welding consumables

A broad portfolio of wire completes VDM Metals' offering: VDM produces wire in fine and ultra-fine gauges down to a diameter of 0.004 in (0.1 mm), heavy gauge and section wire as well as welding wire.

Comprehensive customer support

Customer relationships with VDM Metals mean access to a variety of first class services – services that really make the difference. Our ultimate objective is to provide fast and reliable supplies of nickel alloys and customized solutions that maximize your economic efficiency.



Technical customer support

From selecting the right materials to any request on specifications, properties and fabrication characteristics – VDM Metals' Application Engineering team will be more than happy to provide you with first hand answers and support, relying on their technical and metallurgical background and experience in all fabrication matters of VDM Metals' materials.

Material and corrosion tests

Because we want to remain top of the class with every product, we leave nothing to chance in the field of quality management. During their production, our materials pass numerous tests in terms of quality and accuracy, aiming to meet not only the application's principal requirements but also the more specific needs and specifications of our customers.

Welding Competence Center

With our state-of-the-art welding Competence Center we are not only capable to test different materials and welding consumables or new and unconventional materials combinations, but also to train your staff in theory and practice. Make use of our know-how – we are happy to welcome you and your team in our Welding Competence Center.

Research and Development (R&D)

The performance of our materials depends decisively on their chemical composition. This may be surprisingly simple or highly complex, but in every case it is the result of intensive R&D work. Our aim is not just to develop new materials but also to sound out hidden performance potentials in market-proven alloys which we can then qualify for new applications. Our R&D experts accompany the projects, sometimes right up to commissioning and start-up. The solutions that evolve find their way into new products, as well as techniques and processes.

Access to VDM Metals' Service Centers

Reliable delivery of small quantities at short notice around the globe – this encapsulates the daily business tasks of our Service Centers. We are looking forward to introducing the materials and types of products that we stock and which add-on options we are able to offer at our individual locations in Europe, Asia and Australia.

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