

DENSIMET®

INERMET®

tungsten heavy alloys



The basis of intelligent technology

Plansee is the world's leading manufacturer of powder-metallurgically processed refractory and special metals. Based on our core competencies in the areas of high-performance materials, forward-looking applications and technologies, we have been manufacturing products and components made from molybdenum, tungsten, tantalum, niobium, chromium and their alloys for 100 years.

Being a leader in technological innovation, we are consistently working on optimising materials and meeting new mechanical, chemical and physical demands arising from the practical needs of our clients.

Contents

Plansee tungsten composite materials	Page
Advantages of DENSIMET® and INERMET®	4
Manufacture of DENSIMET® and INERMET® products	5
Product range and material properties	6-7
Medical technology	8
Aerospace industry	9
Automotive industry	10
More industries and applications	11-12
Machining of DENSIMET® and INERMET®	13
Further Plansee high performance materials	14

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Advantages of DENSIMET® and INERMET®

Plansee DENSIMET® and INERMET® composite materials are heavy metals with a high tungsten content (> 90 %) and a NiFe or NiCu binder phase.

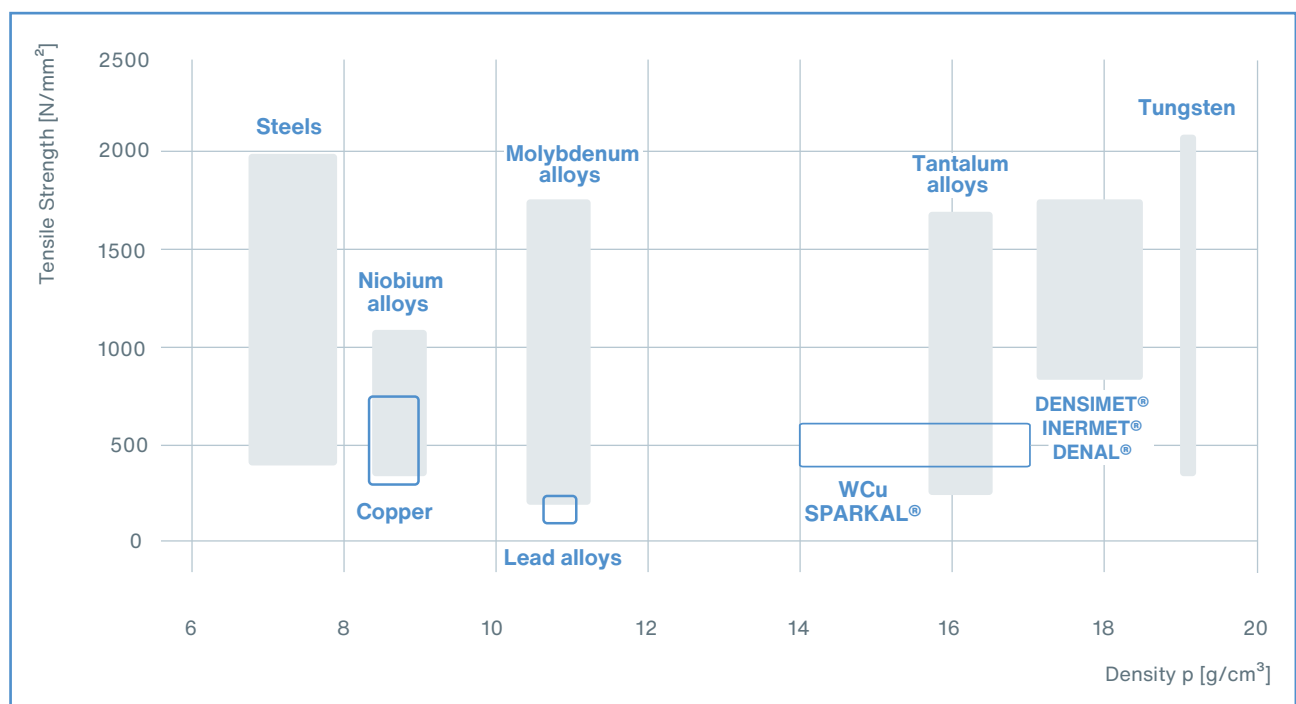
Particular material properties

- high density of 17.0 to 18.8 g/cm³ (similar to pure tungsten)
- better machinability compared to pure tungsten
- inexpensive manufacture of complex products and components
- high Young's modulus and very good mechanical properties
- high absorption capacity for X-rays and gamma rays
- harmless to the health and environment

DENSIMET® alloys are also characterised by their excellent strength and ductility, while another clear advantage of INERMET® alloys lies in their non-magnetic characteristics.

Density comparison of heavy metals

Heavy metals for technical applications are generally defined as materials with a density higher than that of steel (8g/cm³).

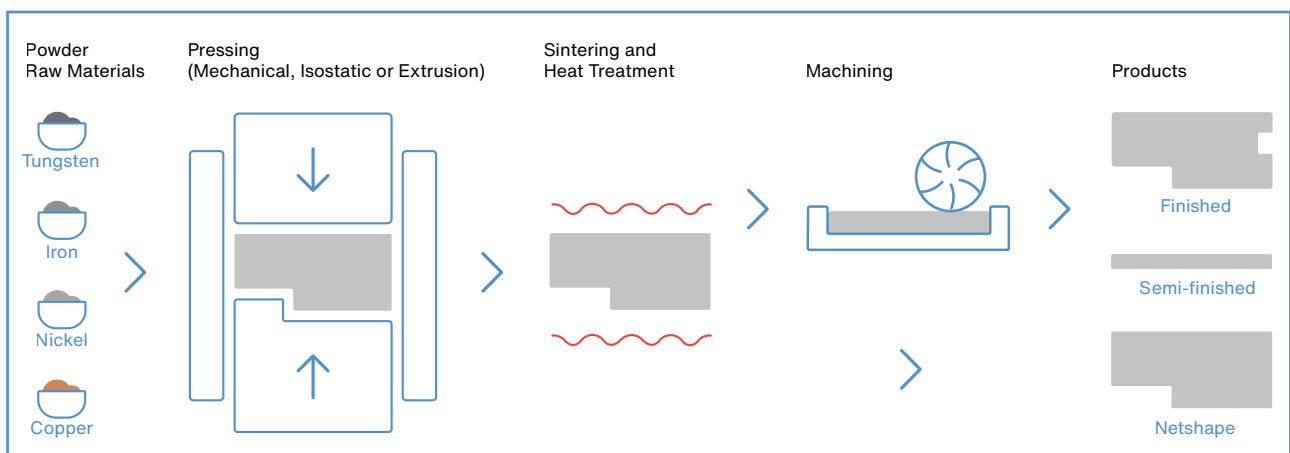


Density comparison of heavy metals

Manufacture of DENSIMET® and INERMET® products

Plansee DENSIMET® and INERMET® products are manufactured using powder metallurgy. All stages of production, from the powder to the finished product, comply with the Plansee quality standards, thus exceeding the ISO 9001 requirements. In order to manufacture DENSIMET® and INERMET®, mixtures of powdered metals are pressed and liquid-phase sintered to obtain a 100-percent dense and solid material. The sintered product can be supplied as a semi-finished product, near-net-shape product or finished product. Upon customer's request, our DENSIMET® and INERMET® components can be adapted by shaping and heat-treatment techniques to meet specific application requirements.

Plansee DENSIMET® and INERMET® materials comply with the AMS-T-21014 and ASTM-B-777-99 (MIL-T-21014) specifications.



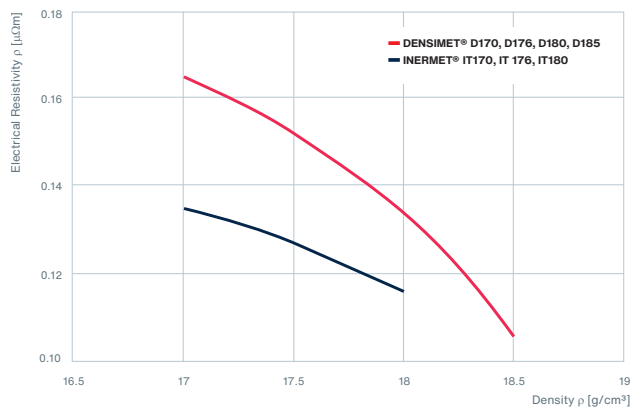
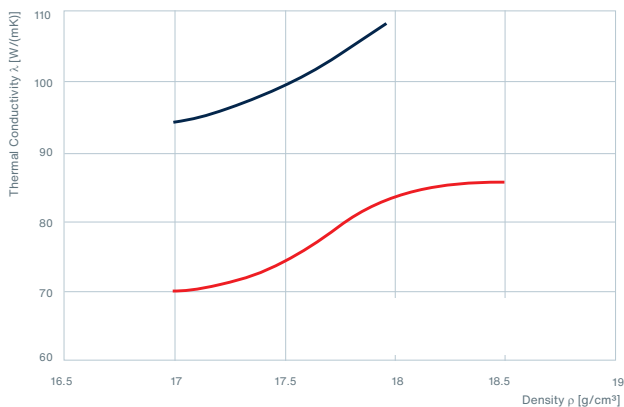
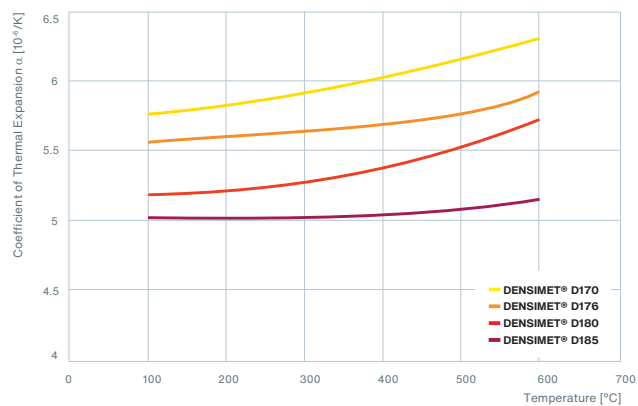
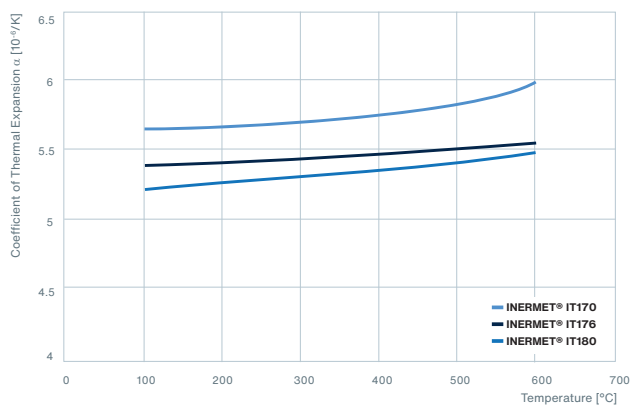
Manufacturing process of DENSIMET® and INERMET® products

Plansee supplies semi-finished products such as plates and rods as well as finished parts according to the customer's drawing.

Product range and material properties

Material	Abbreviation	Chemical composition [%]		Nominal density	ASTM-B-777/07 Class
		W	Rest		
Weakly ferromagnetic					
DENSIMET® 170	D170	90,5	Ni, Fe	17,0	1
DENSIMET® 176 / W	D176 / DW	92,5	Ni, Fe	17,6	2
DENSIMET® 180	D180	95	Ni, Fe	18,0	3
DENSIMET® 185	D185	97	Ni, Fe	18,5	4
DENSIMET® 188	D188	98,5	Ni, Fe	18,8	
DENSIMET® D2M	D2M	90	Ni, Mo, Fe	17,2	
Paramagnetic					
INERMET® 170	IT170	90,2	Ni,Cu	17,0	1
INERMET® 176	IT176	92,5	Ni,Cu	17,6	2
INERMET® 180	IT180	95	Ni,Cu	18,0	3

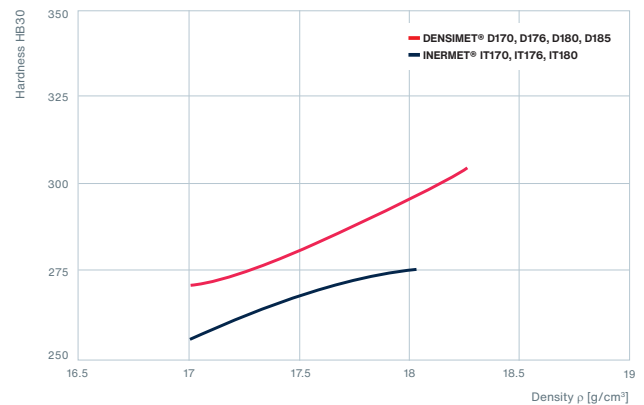
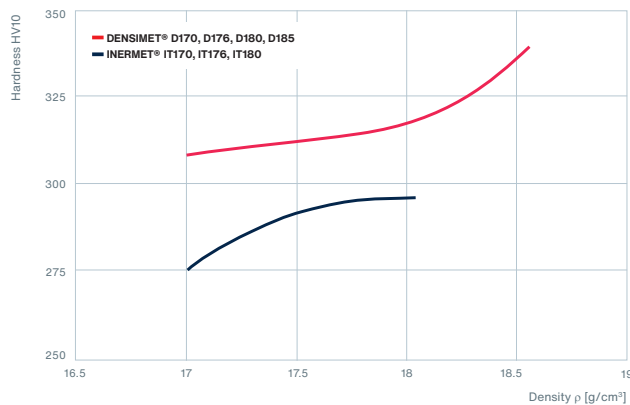
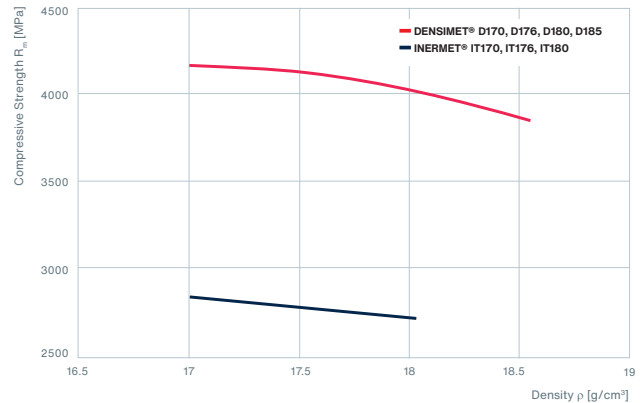
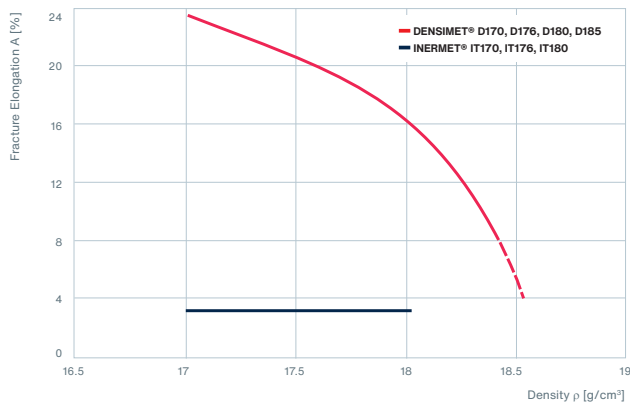
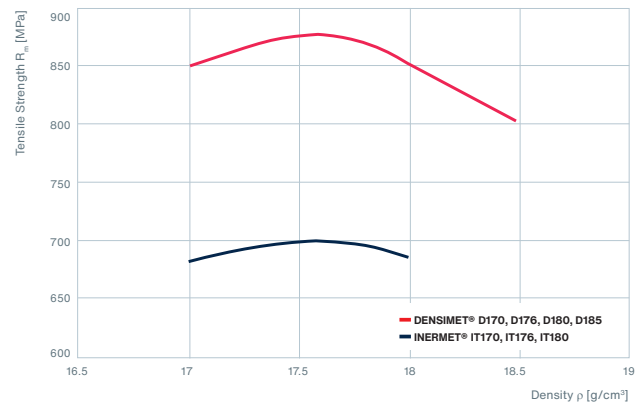
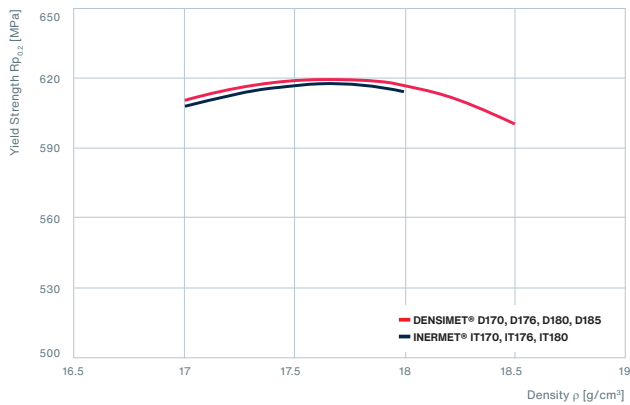
Physical properties – typical values



Statements about certain properties are made to the best of our knowledge but are offered without guarantee.

Mechanical properties – typical values

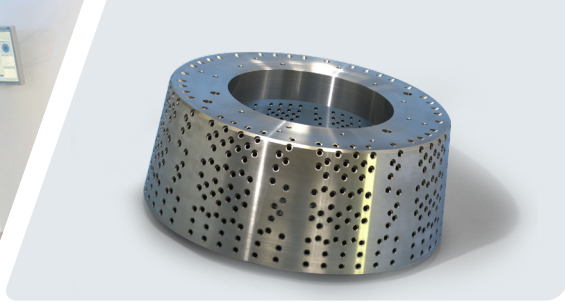
	D170	IT170	D176 / W	IT176	D180	IT180	D185
Young's modulus E [GPa]	340	330	360	350	380	360	385
Modulus of rigidity G [GPa]	140	125	145	135	150	140	160



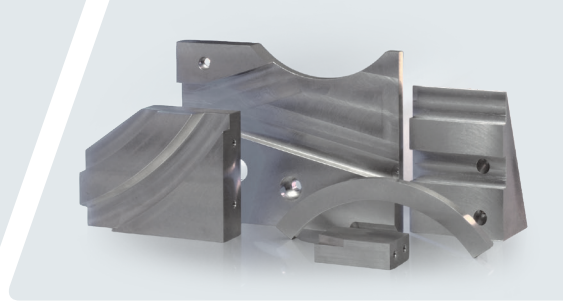
Some mechanical properties of tungsten-based heavy alloys depend on the pre-treatment of the starting materials, on the manufacturing conditions and on the dimensions of the shaped parts.



Leksell Gamma Knife PERFEXION®
neurosurgery using a DENSIMET® collimator,
Photo: Elekta



Collimator device for radiotherapy



Shieldings for linear accelerators

Medical technology

With a density in the range of 17 up to almost 19 g/cm³ and a high X-ray and gamma ray absorption capacity, DENSIMET® is the ideal material for collimators and shielding components in radiotherapy.

In comparison to other materials DENSIMET® tungsten alloys have exceptional stability and freedom from distortion. The good machinability of DENSIMET® allows the production of complex geometries according to customer drawings.

Collimators

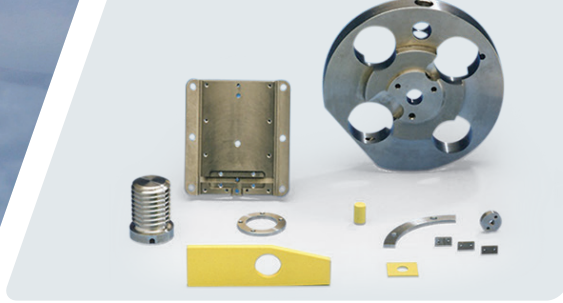
DENSIMET® collimators are channels for filtering radiation, which concentrate the beam directly onto the treatment site and protect the surrounding healthy tissue.

Shielding components for linear accelerators

Shielding components are built into linear accelerators to ensure the protection of the surrounding area right up to the end collimator.



Helicopter blades are balanced by DENSIMET® and INERMET® components,
Photo: Eurocopter



Balancing weights for navigational instruments



Application of DENSIMET® in avionic Systems,
Photo: EXM Company H. Berenger

Aerospace industry

Balancing weights

Thanks to their high densities, DENSIMET® and INERMET® are particularly suitable for balancing rotating systems such as in:

- propellers or helicopter blades
- rudders
- avionics
- radar systems
- targeting pods

Because of its non-magnetic properties INERMET® is especially used in avionic systems.

Thanks to a blend of innovation, process monitoring and strict quality inspections our products meet the most demanding of requirements. Plansee balancing weights are classified as FSP (Flight Safety Parts) requiring approved and consistent production processes which fulfil the highest standards in terms of traceability and repeatability.



VW Touareg V10-TDI,
Photo: Volkswagen AG



VW V10-TDI crankshaft,
Photo: Volkswagen AG



D180 counterweights for
high-performance engines

Automotive industry

DENSIMET® and INERMET® components are applied for high-performance combustion engines requiring high mass at low volume. Plansee quality products meet the requirements of engines in Formula 1 vehicles as well as of premium SUVs, heavy goods vehicles and large diesel engines.

Crankshaft balance weights

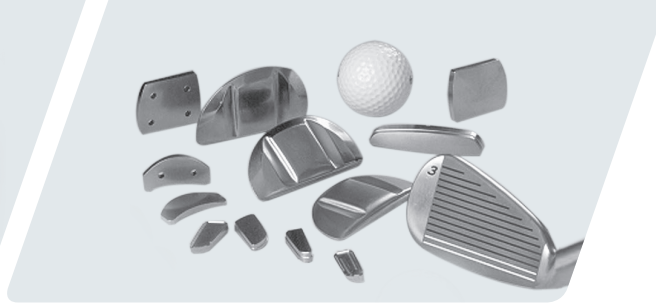
One of the main requirements in engine development is to achieve the most compact and space-saving design possible. Plansee components made of DENSIMET® and INERMET®, with a density of up to nearly 19 g/cm^3 , are especially well-suited for use in crankshaft and flywheel balance weights.

Absorbers and dampers

Because of their high density values, high Young's modulus and outstanding mechanical properties, DENSIMET® and INERMET® tungsten alloys are particularly well suited for manufacturing damper and absorber components in the drivetrain.



DENSIMET® for use
in oscillating weights



Optimised centre of gravity
with DENSIMET® weights

More industries and applications

DENSIMET® and INERMET® are high-strength alloys with high density and good machining properties, making them the ideal solution to improve your products and performance. DENSIMET® and INERMET® inserts increase the mass forces, thus improving the efficiency of precision devices.

Watch industry

Its non-magnetic properties, combined with its non-porous characteristics and precise machinability, are reasons why INERMET® is chosen by leading watchmakers for use as oscillating weights.

Optical industry

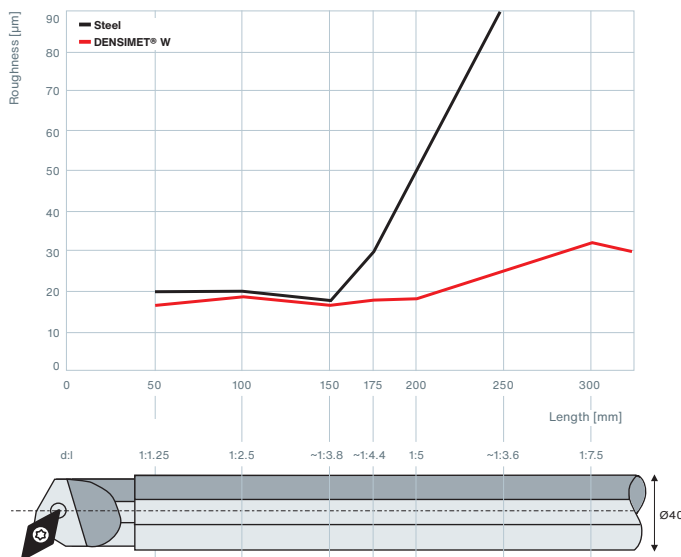
Complex-shaped DENSIMET® other INERMET® weights are used for balancing microscopes and optical precision instruments.

Sports equipment

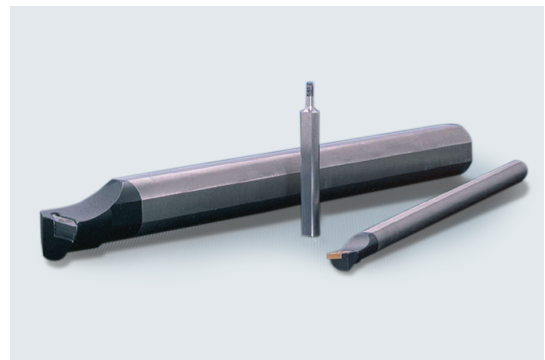
Plansee DENSIMET® and INERMET® materials are used as a lead substitute for sports equipment in order to protect health and environment.

Precision tools

Deep hole drilling requires the use of high-precision tools with long, low-vibration tool holders. Thanks to its high density, its high Young's modulus and its excellent mechanical properties, DENSIMET® is both solid and vibration absorbent, making it the ideal material for tool holders and high-speed spindles.



Surface finish comparison of fine-turned test bars



DENSIMET® boring bars used for machining

Short delivery times:

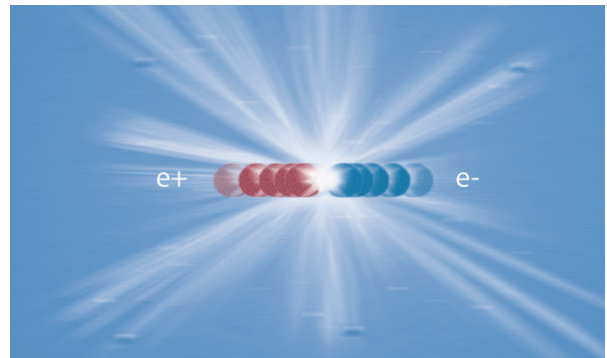
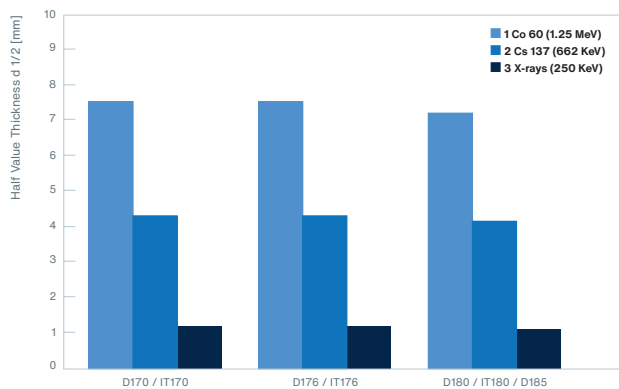
Dimensions from diameter 3 to 62 mm and beyond are available from our stock, enabling us to guarantee short delivery times.

Equipment for the foundation engineering industry

In construction engineering vibratory hammers are used for pile driving. At the heart of every vibratory hammer is a transmission unit with rotating eccentric weights, which convert the vibration energy into sinusoidal vertical forces. For deep soil compaction out-of-balance DENSIMET® weights are used to increase the vibratory forces.

Industrial radiation technology

Thanks to their high absorption capacity for X and gamma rays, shieldings made from DENSIMET® are indispensable components applied in industrial radiation technology. Parts made of high-density tungsten composite materials are applied in particular to produce transport containers for radioactive isotopes and as shielding for linear accelerators.



Half value thickness against X-rays

Machining of DENSIMET® and INERMET®

Milling

Use the CERATIZIT milling tool systems Silverline and MonsterMill with positive cutting edges the following geometry:

Rake angle Cutting edge inclination Hard metal grades	0° through + 10° 0° through + 5° H 216 T / H 210 T / AMZ
VHM end mill micrograin K10 uncoated	DIN 2535 HB
Cutting speed [m/min]	vc = 70 - 150
Feed / tooth [mm]	fz = 0.03 - 0.15
Coolant	dry

Lathing

Tools	Ceratizit Maxilock-S, Hard metal Grades H210T / CTPX
Cutting speed [m/min]	vc = 80 - 100
Feed [mm/U]	f = 0.05 - 0.35 (depending on corner radius)
Cutting depth [mm]	ap = 0.3 - 0.6 (depending on type of insert)
Coolant	Emulsion or Oil

Drilling

Drill diameter	< 18mm
Drill bit	VHM WTX Feed
Cutting speed [m/min]	HM: 30 - 70
Drill diameter	≥ 18mm
Drill bit	WTX indexable drill
Cutting speed [m/min]	HM: 10 - 50
Insert taps	WTX-CHANGE-UNI.20,80.R.DPX74S
Feed [mm]	f = 0.03 - 0.10
Coating	DPX 74S
Coolant	Emulsion or Oil

Thread Cutting

Inserts	Hard Metal coating CWK20 / CWN1525
Cutting speed [m/min]	vc = 50 - 80 full cooling with emulsion or oil
Infeed	ap = 0.002mm / pass

Oxidation: Densimet tungsten alloys start oxidizing slightly as of 600 °C. However, experience in the casting industry shows that no problems arise. The temperature of the mold when it is opened is somewhere between 400 °C and 500 °C and commonly applied coatings offer additional protection. When the mold is filled, the melt displaces the atmosphere, thus preventing oxidation. Components such as thermowells which are simultaneously exposed to the melt and to oxygenous atmospheres will generally need to be protected against oxidation.

Further Plansee high performance materials

Based on our long-standing experience in the field of powder metallurgy, we supply a wide range of products made from high-performance materials. Besides DENSIMET® and INERMET® tungsten alloys, Plansee is also a leading manufacturer of:

- Molybdenum and Mo alloys
- Tungsten and W alloys
- Tantalum and Ta alloys
- Niobium and Nb alloys
- Chromium and Cr alloys
- Composite Materials

Selection of Plansee products made of high-performance materials:



Sputtering targets



Semiconductor base plates



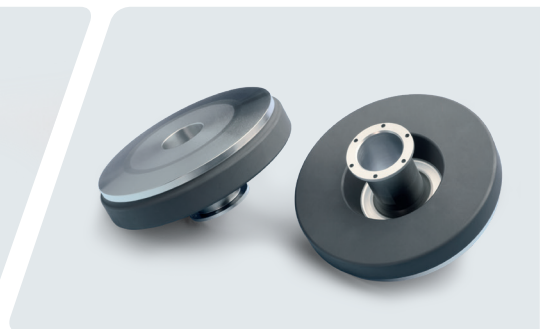
CuCr contacts



Glass melting electrodes



Wires for the lighting industry



Various finish types of X-ray rotary anodes

Close to the customer – our global network

Plansee manufactures and markets its products worldwide. Production sites in Europe, the USA, Japan, India, China, and Korea as well as a global network of sales subsidiaries and sales partners enable outstanding customer service and product quality delivered by local teams. Stronger than any alliance and more diversified than single producers, Plansee is the most reliable source for high-performance components made of refractory metals.

For more information and local contacts, please visit our website:

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We reserve the right to make technical changes for improvement of the product.
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