Deloro
Wear Solutions

WEAR SOLUTIONS

COMPONENTS

deloro.com

DELORO WEAR SOLUTIONS GMBH

Deloro Wear Solutions is a global world-class provider and manufacturer of innovative metallic wear solutions. We put at your disposal our metallurgical and process technology expertise to enhance performance of your critical components or processes exposed to any combination of mechanical, corrosive or heat related wear. Your productivity is our mission!

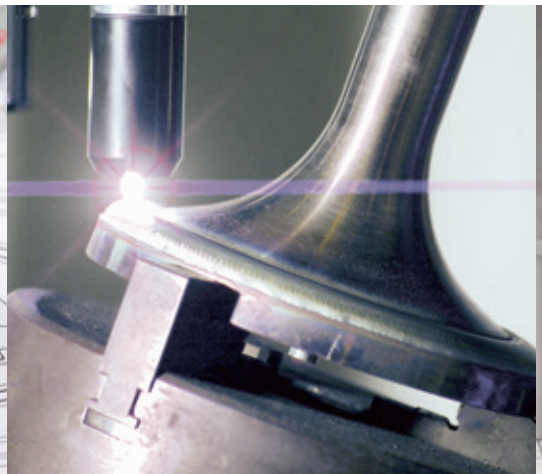
Solid cobalt-, nickel- and iron- based alloy castings, coatings, as well as overlay materials, combat wear in aggressive environments in our customers' operations in multiple industries.

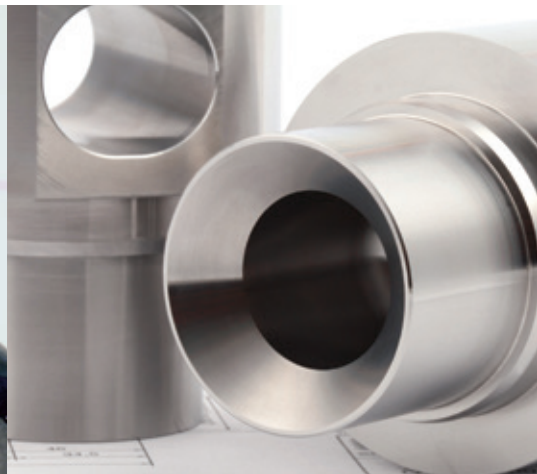
TABLE OF CONTENTS

ALLOY & CUSTOM ENGINEERING

Deloro Wear Solutions manufactures solutions that extend component life, reduce unplanned equipment downtime and decrease maintenance expenditures.

Everything we do begins with the identification of your high-temperature wear or corrosion problems in operating environments where equipment downtime or failure is costly to your operations. This identification, coupled with a thorough understanding of the wear mechanisms and operating environment, will lead to the component design, alloy selection and manufacturing process selection that are best suited for your problem. Our support is highly present in numerous industries that are negatively affected by wear, corrosion and high temperatures. To best serve these industries, Deloro Wear Solutions has developed more than 200 alloys with unique characteristics and properties. Our development engineers can also create customised alloys specifically for you and your needs.





ALLOY FAMILIES

Stellite™ Alloys

Stellite™ cobalt-based alloys are noted for their resistance to corrosion, erosion and abrasion at elevated temperatures (up to 800ºC).
There are more than 20 Stellite™ alloys in this family.
A special Stellite™ alloy: Stellite™ 6B is a wrought (hot forged) material with outstanding resistance to most types of wear and is extremely resistant to seizing or galling. High temperatures have little effect on the toughness and dimensional stability of this alloy.

Deloro™ & Nistelle™ Alloys

Deloro™ nickel-based alloys exhibit excellent corrosion, abrasion and wear resistance (up to 600ºC) and have a wide melting range allowing them to be applied by the spray and fuse and powder-weld processes. Nistelle™ nickel-based castings are noted for their outstanding corrosion resistance and are offered in a full range of ASTM, AMS and ACI specifications.

Tribaloy™ Alloys

These cobalt- and nickel-based alloys feature a hard intermetallic laves phase, dispersed in a tough matrix of eutectic or solid solution. Tribaloy™ alloys exhibit outstanding resistance to high-temperature wear, galling, corrosion and are particularly suitable for use where lubrication is a problem.

700 Series™ Alloys

This family of cobalt-based alloys uses chromium and molybdenum as major alloying elements. These offer good wear resistance with superior corrosion resistance in reducing environments of hydrochloric, phosphoric and napthanic acid.

Additional Alloys

Stelcar™ and Super Stelcar™ alloys are composite alloys with varying percentages of carbide in cobalt- and nickel-based matrices. These hardfacing alloys are designed for extremely abrasive and erosive environments. Delcrome™ iron-based alloys provide excellent wear resistance where heat and corrosion are not factors.

Industry-leading wear-resistant solutions in alloys-based science, hardfacing, coating services and providing components that excel in wear resistance in extreme temperatures and applications.

ALLOY characteristics

Standard - ALLOYS	Nominal analysis[1]								Typical HRC[2]	Typical ELONG. %	Typical Applications
	Co	Cr	W	C	Ni	Mo	Fe	Others			
COBALT-BASED ALLOYS											
Stellite™ alloy 3	Bal.	31,0	13,0	2,5	<3,5	<1,0	<3,0	Si, Mn	51 - 58	<<1	High-temperature with severe abrasion, extrusion dies non ferrous alloys
Stellite™ alloy 4	Bal.	30,0	14,0	1,0	<2,0	<1,0	<2,0	Si, Mn	45 - 49	<1	Corrosion with erosion on pump parts
Stellite™ alloy 6	Bal.	28,0	4,5	1,2	<3,0	<1,0	<3,0	Si, Mn	36 - 46	<1	Some wear and corrosion with ductility
Stellite™ alloy 6B	Bal.	30,0	4,5	1,1	<3,0	1,5	<3,0	Si, Mn	33 - 43	11	Stock product with wear and corrosion resistance, excellent ductility
Stellite™ alloy 6K	Bal.	30,0	4,5	1,6	<3,0	1,5	<3,0	Si, Mn	40 - 50	4	Excellent wear and corrosion resistance for knives and scrapers
Stellite™ alloy 12	Bal.	29,0	8,5	1,8	<3,0	<1,0	<3,0	Si	46 - 51	<1	High-temperature with wear resistance , Timber - Saw Tips
Stellite™ alloy 20	Bal.	33,0	16,0	2,5	<3,0	<1,0	<3,0	Si	53 - 59	<<1	Pump sleeves, rotary seal rings, bearing sleeves
Stellite™ alloy 1040	Bal.	32,0	17,0	2,0	<1,5		<1,0	Si, Mn	51 - 56	<<1	High pressure valves
Stellite™ alloy 21	Bal.	28,0		0,3	3,0	5,2	<3,0	Si	25 - 30	9	Good ductility and corrosion resistance
Stellite™ alloy 25	Bal.	20,0	14,0	0,1	10,0	<1,0	<3,0	Si	<20	5	High-temperature nitric acid
Stellite™ alloy 31	Bal.	26,0	7,5	0,5	10,0		<2,0	Si	28 - 35	10	Aerospace engine parts
Stellite™ alloy 250	Bal.	28,0		0,1			21,0	Si	19 - 29	8	High-temperature oxidation resistance
Stellite™ alloy 706	Bal.	31,0		1,2	<3,0	4,0	<3,0	Si	39 - 43	1	Wear and corrosion with ductility
Stellite™ alloy 712	Bal.	31,0		1,6	<3,0	8,0	<3,0	Si	47 - 51	<1	High-temperature with wear and corrosion resistance
Stellite™ alloy 720	Bal.	33,0		2,5		18,0	<3,0	Si	53 - 60	<1	High-temperature corrosion, severe wear and abrasion
Tribaloy™ alloy T-400	Bal.	8,5		<0,08	<1,5	28,0	<1,5	Si	51 - 58	<1	Good wear and corrosion resistance
Tribaloy™ alloy T-400C	Bal.	14,0		<0,08	<1,5	27,0	<1,5	Si	48 - 56	<1	Improved oxidation corrosion and abrasion resistance
Tribaloy™ alloy T-401	Bal.	17,0		0,2	<1,5	22,0	<1,5	Si	45 - 50	1	Enhanced ductility with superior corrosion and wear resistance
Tribaloy™ alloy T-800	Bal.	18,0		<0,08	<1,5	28,0	<1,5	Si	50 - 58	<1	High-temperature with severe corrosion, wear, and abrasion
ULTIMET™	Bal.	26,0	2,0	0,1	9,0	5,0	3,0		<25	15	Valve parts, forging dies, incinerator nozzles

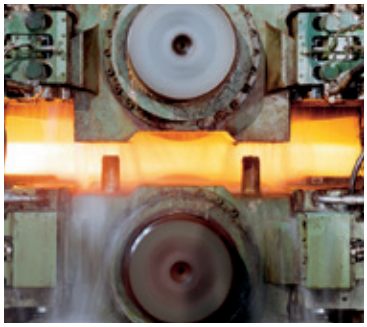
Standard - ALLOYS	Nominal analysis[1]								Typical HRC[2]	Typical ELONG. %	Typical Applications
	Co	Cr	W	C	Ni	Mo	Fe	Others			
NICKEL-BASED ALLOYS											
Nistelle™ alloy C		17,0	5,0	0,1	Bal.	17,0	6,0	Si, V	17 - 27	4	Hot metal stamping, piercing points, drop forging dies
Nistelle™ alloy Super C		23,0		0,1	Bal.	18,0	<1,0	Si	17 - 27	15	Similar to Nistelle™ C with improved wear and corrosion resistance
Nistelle™ alloy 625		21,0		<0,1	Bal.	8,5	<5		90 HRB	25	Vacuum melted high-temperature Ni-based superalloy
Deloro™ alloy 40		12,0		0,4	Bal.		2,5	Si, B	35 - 42	NA	Nuclear valves
Deloro™ alloy 50		12,0		0,5	Bal.		4,0	Si, B	42 - 58	<1	Wear and corrosion resistance
Deloro™ alloy 60		13,0		0,7	Bal.		4,0	Si, B	57 - 62	<1	Extrusion press, screw barrel, pump impeller, plunger
IRON-BASED ALLOYS											
Delcrome™ alloy C		21,0		3,8			Bal.		52 - 56	<<1	Good wear resistance, not involving severe heat
Delfer™ alloy B	8	17,0		3,0		15,0	Bal.	Si, Mn, V	58 - 65	<<1	Abrasive wear resistance, not involving severe heat
Delcrome™ 50 V		26,5		2,8			Bal.	Si, Mn, V	50 - 56	<<1	Grinding discs

[1] Nominal analysis is a guideline only for standard product. Does not include all incidental elements and may differ depending on the exact specification/ standard used when ordering.
[2] Depending upon the process parameters the hardness of the alloy may vary from that provided in the above table.

These Alloys are our common standard selection. If required, we are able to deliver Stellite grades which are not so common and to design customized alloys. Please contact us for more details.

SOLID COMPONENTS PROCESSES

Solid components benefit from wear properties that are consistent throughout the component, particularly in shapes and configurations that would be difficult or impossible to protect otherwise. Solid components are produced by: casting, powder metallurgy or wrought material processes. With our in-house, fully equipped and staffed machine shops, we are able to finish machine solid components to your surface and dimensional requirements.



Wrought Material

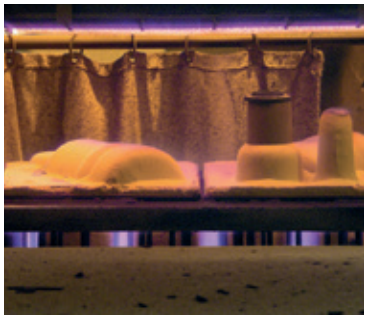
Stellite™ 6B and Stellite™ 6K are wrought materials whose physical properties are enhanced as the grain structure of the metal changes during plastic deformation. During this forming process, the wrought material achieves higher strength than cast material of the same chemistry. Stellite™ 6B is produced in both bar and sheet form while Stellite™ 6K is produced only in sheet form.
These materials are then cut to shape (laser or water jet) and machined into components to a customer's drawing.

Powder Metallurgy

Powder metallurgy is a process for making fully dense components with uniform microstructures from metal powder, which are free of non-metallic inclusions and defects. A mixture of metal powder and a binder is formed to shape through either a pressing or extrusion process. This preform is heated to a temperature just below the melting point of the alloy. During this sintering process, the diffusion of metal atoms between the alloy particles produces strong bonds between the particles. This process is particularly efficient for the production of large quantities of small parts with a simple shape, such as balls and saw teeth.

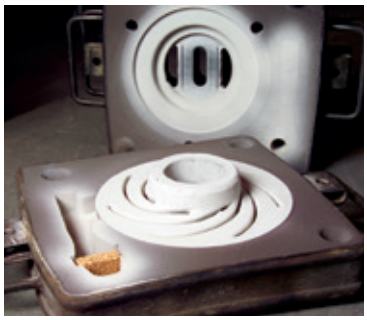
HIP Technology

With HIP we include Powder Metallurgical Steels, Bi-Metallic and Densifications Service to our capabilities.
By Powder Metallurgy application the powder must be encapsulated. After high pressure sintering, the capsule is stripped. Parts can then be machined to your specifications. With the Bi-Metallics applications, different material properties can be combined and a coating could be applied in one step, encapsulation is necessary. With our Densifications Service, parts with enclosed porosity can be densified, no encapsulation is then necessary. This way, we are able to achieve the highest possible density and consistent annealed microstructure.



Resin Shell

Complex molds with integrated cores can be produced by the resin shell molding process, allowing the production of parts with complex geometries. The process features comparatively good near-net-shape accuracies and good surface quality. Resin-coated zircon sand is poured onto a heated pattern plate; the resin is cured and one half of a mold is formed. Two halves of a mold are then bonded together, ready for casting.



Sand Casting

The sand casting process is typically used for larger parts with thick cross sections. A sand mold is created using a relatively inexpensive pattern (often wood) in two halves. The halves are assembled, along with any cores required, to form the pouring mold. Sand castings can be poured in a wide range of cobalt, nickel and stainless steel alloys. As required by your application; these castings can be machined to your print.

Centrifugal Casting

Centrifugal casting is ideal for pouring high-quality cylindrical blanks that will be machined into ring or tubular-shaped components. As the name implies, a centrifugal force is employed by spinning a cylindrical mold around its long axis. This exerts pressure on the molten metal, pushing it against the outside walls of the mold, resulting in a very dense blank with a fine, uniform grain structure. These centrifugal casting blanks are subsequently finish machined into components.

Investment Casting

Precision investment casting is ideal for intricately shaped components.
The lost wax, ceramic shell process produces high near-net-shape components with good-as-cast surface finishes, minimizing machining requirements.
Alloys are melted in high-frequency induction furnaces, offering complete flexibility and metallurgical dependability. A wide range of cobalt, nickel and stainless steel alloys can be poured in our investment foundries. All castings poured can be produced to print in our well-equipped machine shops.

Vacuum Investment Casting

Similar to air-poured investment casting, this process utilizes a vacuum to remove air from the ceramic mold, allowing the pressure differential to fill the mold while eliminating oxidation during the pouring process. This is particularly important when alloys include elements such as aluminum or titanium.
This casting method is used most often to pour aerospace and industrial gas turbine components.

HARDFACED COMPONENTS PROCESSES

Hardfacing of components may provide the best solution in situations where wear is localized or where the best material is difficult to cast. Our wide range of materials and surfacing processes enable us to take a targeted coatings approach to solve your difficult wear problems.

SPRAYED COATINGS

Plasma Spraying

High-quality and dense coating, ideal for high melting-point materials.

Flame Spraying (Spray and Fuse)

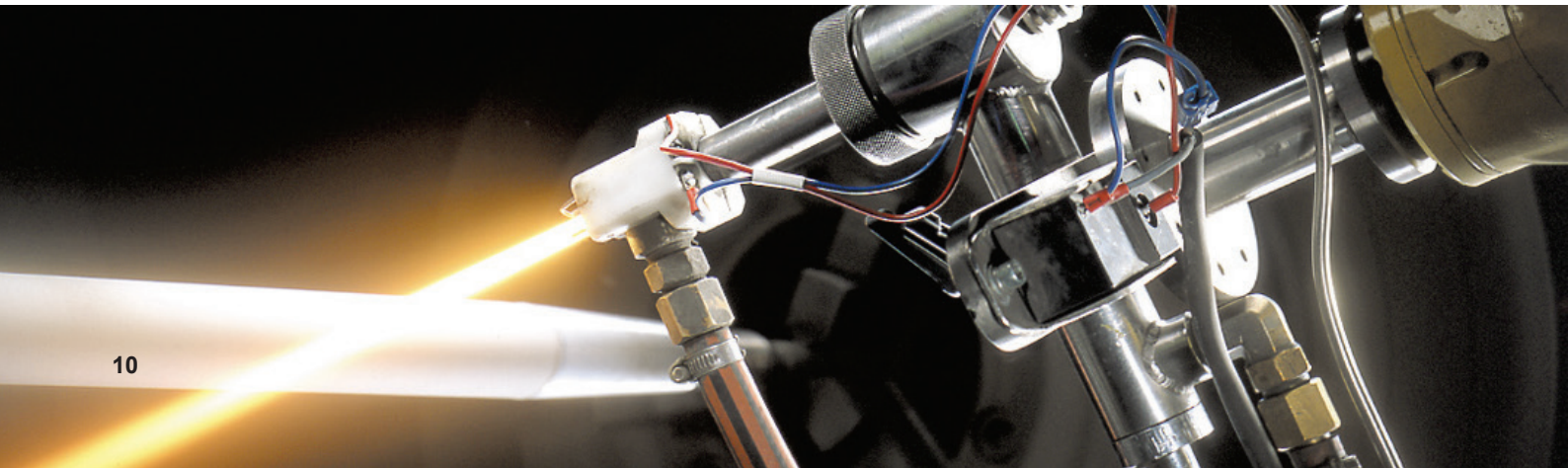
Widely applicable, relatively low cost, if fused – metallurgical bond with substrate, liquid and gas tight.

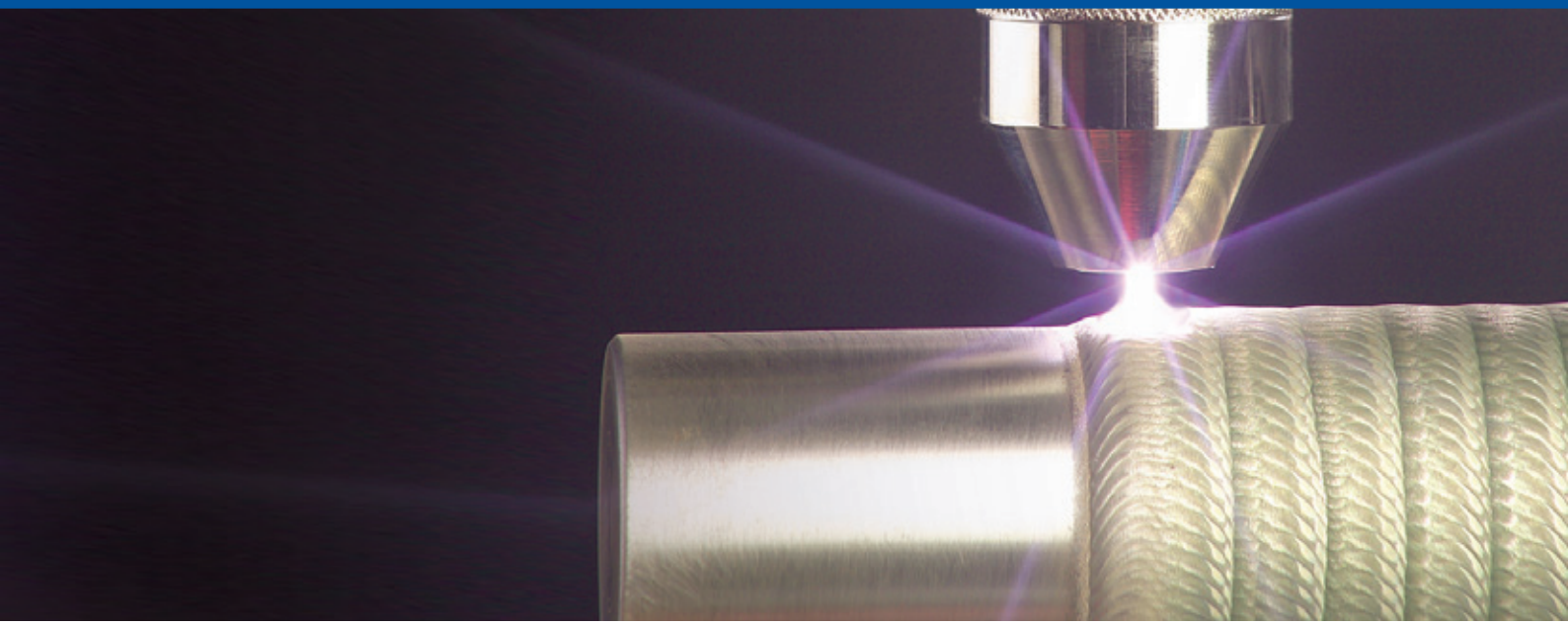
High Velocity Oxygen Fuel (Jet Kote™ HVOF)

Very dense coatings, excellent bonding, minimal metallurgical changes and minimal temperature effects to the substrate.

Powder Welding

For deposition of smooth, thin, well-bonded layers on flat surfaces, minimizes oxidation and distortion.





WELDED OVERLAYS

Plasma Transferred Arc (PTA)

Highly automated, high powder utilization, low dilution, wide range of hardfacing materials available.

Manual Metal Arc

Flexible, low cost, mobile, ideal for repairs.

Metal Inert Gas Weld Deposition, Submerged Arc Welding

Very flexible, can be partially or fully mechanized, suitable for a wide range of applications.

Laser Weld Deposition

Low heat input, stress-free overlay, fast cooling rate higher hardness, finer microstructure.

TIG and Oxy-Acetylene Welding

Simple manual operation, good control of the welding arc, can be mechanized, low dilution.

Hardfacing Equipment and Material Solutions

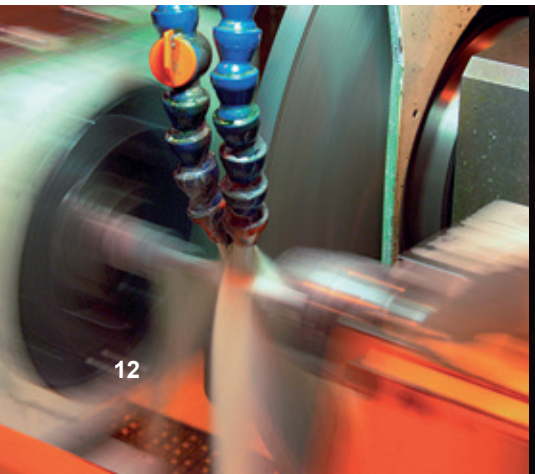
In addition to providing coating services, Deloro Wear Solutions designs and manufactures state-of-the-art PTA equipment, customized to work with our materials on your shop floor.
Consider the added operational control you achieve with a turn-key equipment and material solutions.

For further information ask for our brochure “Hardfacing alloys”

FINISH MACHINING OF COMPONENTS

Deloro Wear Solutions component production facilities offer full finish-machining capability, providing customers with a one-stop, ready-to-use component. We are the experts in machining the alloys we pour or apply. Our highly skilled machine shop staff with years of experience, along with our state-of-the-art CNC equipment, enable us to produce your components to your drawing. We have capability in these areas:

+ Turning
+ Milling
+ Wire / Die Sink EDM
+ Honing
+ Grinding
  (cylindrical, centerless, knife, double disc)
+ Lapping
+ Balancing
+ Drilling



Mechanical Capabilities

Machining Process		Max. Component Dimensions*			
		Diameter	Length	Width	Height
5-axis Lathe / Milling	-	400 mm	1500 mm	-	-
Turning	**Horizontal**	1600 mm (outer)	6000 mm	-	-
	Vertical	2800 mm (outer)	1500 mm	-	-
Milling max. tolerance: ±0.01 mm	-	-	2000 mm	2000 mm	2000 mm
EDM	**Die Sink**	-	625 mm	400 mm	450 mm
	Wire conical up to ±20°	-	400 mm	800 mm	400 mm
Honing max. tolerance: ±0.005mm max. surface finish: Ra=0.1	-	min. 3 mm / max. 350 mm	400 mm	-	-
Grinding max. tolerance: ±0.005 mm	**Surface Grinding** max. surface finish: Ra=0.2		1000 mm	600 mm	-
	Spherical Grinding max. surface finish: Ra=0.2	min. 30 mm (Ball) / max. 500 mm (Ball)	-	-	-
	Profile Grinding max. surface finish: Ra=0.2	240 mm	200 mm	40 mm	-
	Cylindrical Grinding max. surface finish: Ra=0.4	850 mm (outer) / 800 mm (inner)	3000 mm (outer)	800 mm (inner)	-
Lapping max. tolerance: ±0.005 mm max. surface finish: Ra=0.1	**Round**	200 mm	1000 mm	-	-
	Superfinish	700 mm	2000 mm	-	-
	Flat	350 mm	-	-	-

* Please note that these dimensions are for guidance only.
Sometimes, by using special holding methods, there are opportunities to finish components with significantly different dimensions.

INDUSTRIES SERVED

Oil & Gas – Exploration and Production

Stellite™ components are found in MWD and LWD tools, tri-cone bits, mud pulser units, auto chokes, pressure pumps, artificial lift equipment and severe service and safety valves.

Food Processing

Deloro Wear Solutions provides components fabricated from FDA-approved alloys, which are utilized in food handling, processing, bottling and canning equipment.

Power Generation

Stellite™ materials are used in steam handling valves, IGT combustor and hot gas path components (including blades and vanes), IGT frame components, steam turbine erosion shields and nuclear control rod mechanisms. In addition, we are capable of supplying completely assembled power generation steam valves to your print.

Severe Service Valves

Our materials and components are found in severe service metal-seated ball, butterfly and gate control valves.

Automotive & Diesel

Solid Stellite™ components are found in turbo-chargers and EGRs while Stellite™ coating materials are used to protect the sealing surface of engine valves.

Aerospace

We specialize in small to medium-sized structural components such as those found in combustor and hot gas path engine applications or in rod-end bearing applications.

Petrochemical / Chemical

Routine overlays of Stellite™ 6, or more complex remedies such as bimetallic castings are utilized in refineries and FCCU units as nozzles, thermowells, valve trim and bodies, pump components and return bends.

Other Processing Machines and Equipment

Many OEMs use our alloy components within their equipment to ensure longer life and reliability for their machines. You will find Stellite™ materials in virtually all process industries.

QUALITY SYSTEM & CERTIFICATION

Extensive quality systems assure that our components and process control meet your high expectations.
Our facility maintain ISO 9001:2008 certifications and in addition, we hold numerous industry-specific qualifications, as well as specific customer certifications.

Inspection Capability

In accordance with the requirements of our customer's order, we verify and document a wide variety of features by measurement, chemical analysis, radiography and fluorescent penetrant crack detection.
We perform destructive tests as required.

In addition, we have access to several high-quality testing firms who are capable of performing third party inspections and tests. Our certifications, qualifications and testing capabilities are continuously expanding. Please discuss your requirements with our staff.

Approvals / Certifi ations:

Specification	Applies to
DIN EN ISO 9001:2008	Quality Management System
ISO / TS 16949:2009	Automotive
DIN EN ISO 3834-2	Welding Shop
IAEA 50-C-Q / GS-R-3	Nuclear
KTA 1401 & AVS D 100/50	Nuclear
KTA 3201.1 & 3201.3	Nuclear
GTS QM Guideline GTSPA003	Thermal Spraying
DGR 97 / 23 / EG & AD 2000 Bulletin HP 0	Pressure Equipment
AD 2000 Bulletin W0	Pressure Equipment
DIN EN ISO 13485:2012	Medical Devices
ISO 50001:2011	Energy Management

Deloro
Coatings

Offering high-quality coating services utilizing a wide range of cobalt, nickel and iron-based alloys as well as tungsten carbide

Deloro
Microfusione

Leading manufacturing services provider for highly-demanding air- and vacuum-cast super alloy investment castings

Deloro
Wear Solutions

Offering bespoke components, coating services, consumables and equipment

Deloro Wear Solutions GmbH
Zur Bergpflege 51 - 53
56070 Koblenz | Germany
Phone: +49 261 80 88 0
Fax: +49 261 80 88 35
E-mail: wearsolutions@deloro.com
deloro.com