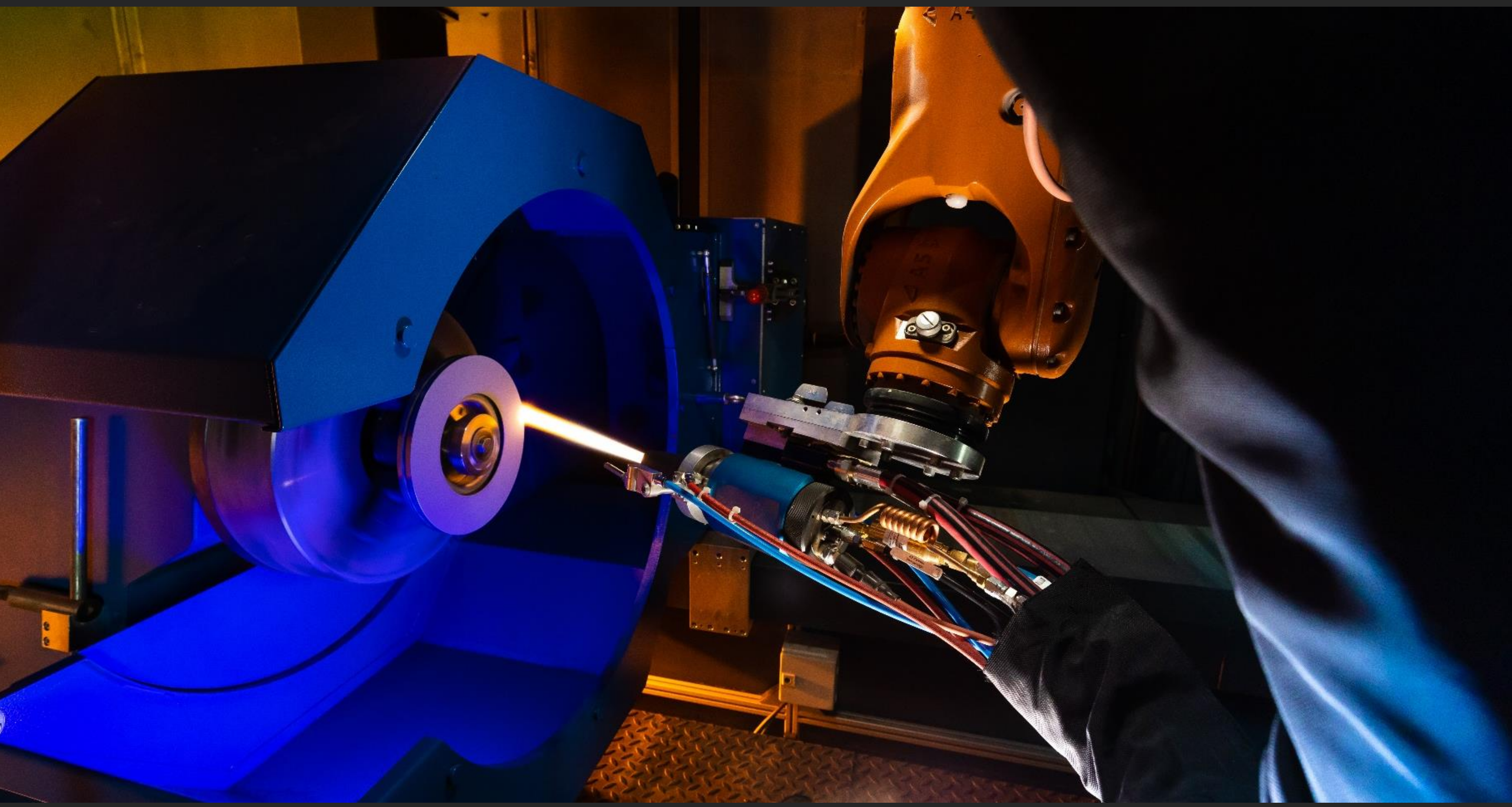
GTV SPRAY POWDER CATALOGUE

according to DIN EN 1274



Version 1.11

APPLICATION AREAS

- Overhaul / repair
- Wear protection
- Corrosion protection
- Bond coats
- Electrical isolation
- Thermal isolation
- Clearance control (Abradable Coatings)

POWDER MORPHOLOGY

- Fused and crushed powders
- Water or gas atomized powders
- Agglomerated and sintered powders
- Clad powders

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APPLICATION AREAS

The technology of thermal spraying permits the manufacturing of adapted surfaces for each application by local deposition of coating materials with optimized properties. Due to the various possibilities to combine coating and substrate materials and due to the large variety of processes and achievable processing conditions, thermal spraying is of utmost significance among the coating processes. In various applications it offers perfect solutions regarding surface technological problems.

The majority of thermal spray applications can be found within the following outlined fields. In practice these fields often overlap. Therefore a multiplicity of proven coating materials exceeds the property profile necessary within individual applications.

OVERHAUL / REPAIR

Technical components are not only subject to changes of shape by wear, but also show deviations due to manufacturing tolerances. Regardless whether cast, forged, sheet metal or machined parts are concerned the various thermal spray processes offer application-adapted possibilities for the restoration of faulty components.
The universal spectrum of spraying consumables offered by GTV enables the customer to select the material either depending on the load or with regard to the compatibility of the coating and substrate material.

WEAR PROTECTION

The optimal choice of a coating material for wear protection of component surfaces depends on the tribological system (materials and surface state of the friction partners, relative movement, lubrication, load). The friction condition can be liquid, boundary or dry friction. Also, in accordance with the chemico-physical boundary conditions different wear mechanisms can occur: abrasion, adhesion, fatigue and / or tribo-chemical reaction.

Abrasion takes place through scratching of the component surface by a substantially harder counterbody or during the interaction with a fluid that contains abrasive particles. Hard, dense and fine-structured coatings have proved to be best suited for this type of tribological conditions. In case of interaction with a fluid that contains abrasive particles the size of hard phases in e.g. WC/Co(Cr) or Cr_3C_2/Ni20Cr coatings has to be adapted to the abrasive particles size in order to provide optimal wear protection function by avoiding local removal of the soft binder phase. Depending on the specific tribological load the spectrum of GTV spraying consumables offers adequate solutions with adapted hardness, hard phase size and distribution within a matrix material and resistance to impact load. In addition to the wear resistance of the coating material one has to consider the kind of applicable finishing and the achievable coating thickness required to ascertain an aspired life time.

Adhesion wear proceeds by formation and destruction of atomic bonds (micro or cold weldings) between the friction partners resulting in tear out of material from one components surface and transfer to the counterbody. Adhesion wear, also called "galling", can be avoided by the use of coatings with low adhesion properties (low surface energy) or adapted lubricating and / or sliding characteristics.

Fatigue wear occurs as consequence of cyclic mechanical or thermo-mechanical load. Accumulative plastic deformation within micro contact areas leads to excess of the materials strain capability and therefore to crack evolution. Crack propagation under ongoing cyclic load finally leads to material removal from the component surface. As crack evolution can originate from microstructure irregularities like pores, phase and grain boundaries that are generally present in thermal spray coatings, a coating designed to resist fatigue wear has to provide high fracture toughness in order to prevent excessive crack propagation. Homogeneous and dense coatings with compressive residual stress state show best suitability for this type of tribological conditions.

The **tribo-chemical reaction** is as a chemical reaction occurring during and due to the tribological load leading to material loss in form of reaction products on one or both friction partners. Tribo-chemical reactions are favored by friction induced rise of (local) temperature. Reaction products like e.g. metal oxides differ from the base material concerning hardness, strain capability, thermal expansion and thermal shock behavior. In the shape of fine particles these oxides can additionally affect the tribological conditions, e.g. by superposition of abrasive wear. Thermal spray coatings protecting component surfaces efficiently against wear due to tribo-chemical reactions need to be chosen under consideration of the environment and the counterbodys chemical composition.

In practice the described wear mechanisms often occur superimposed. E.g. sliding, rolling and oscillation wear can impart all of the described mechanisms simultaneously. Beyond that the prevailing application temperature can substantially influence the material behavior. Therefore spraying feedstock that permits production of coatings that fulfill the sum of partially contradicting demands according to the complex tribological conditions in an optimal way have to be chosen.

CORROSION PROTECTION

Adequate choice of feedstock for production of corrosion protective coatings requires consideration of the substrates chemical properties, the environment in use of the component as well as pressure and temperature in use of the component. Furthermore attention has to be paid whether the corrosion attack is pure based on chemical or electro-chemical reactions. In particular for electro-chemical corrosion attack the influence of potentially existing contact materials, e.g. due to partial coating of the components surface, needs to be taken into account. Choice of a coating material that is nobler than the substrate material can even lead to accelerated corrosion, if there is a location, where the corrosive medium can penetrate the coating down to the substrate surface.

Corrosive attack on the substrate material by the surrounding medium via pure chemical corrosion processes can be prevented by application of chemically more resistant coatings. Also there is the possibility to produce cathodically protective coatings. In that case the less noble coatings corrode instead of the substrate material and thereby provide protective function. Typical examples are zinc and aluminum coatings on steel structures.
Electro-chemical corrosion takes place, if two materials showing substantially dissimilar corrosion potential are in contact by a conductive liquid film. Coatings suppressing the galvanic current flow are utilized to prevent this type of corrosion.

BOND COATS

Bond coats are sprayed as intermediate layers with the aim to improve the adhesion of a functional coating to the substrate. Besides molybdenum that permits local formation of metallurgical bonds at impact of liquid spray particles on the substrate surface due to the materials high reactivity and high melting temperature the spectrum of so called self-bonding coatings provides high adhesion strength. Therefore such coatings are an excellent base for thermally sprayed functional coatings. For production of self-bonding coatings clad powders are used. The powder constituents undergo an exothermic reaction and therefore impinge on the substrate at significantly higher temperature than particles sprayed with homogeneous alloy particles with the same chemical composition. Diffusion processes lead to a local formation of metallurgical bonds. But self-bonding coatings are not only used as bond coats. They are also available with different hardness levels and can be used as functional coatings, e.g. for combined wear and corrosion protection.

A further group of bond coats are ductile nickel or cobalt based alloys that prevent access of corrosive media to the substrate surface, if functional top coats cannot provide this function securely. Hot gas corrosion protective MCrAlY (M := Ni, Co) coatings are also designed in a way that they show an intermediate thermal expansion behavior between typical super alloy substrates and zirconia based thermal barrier top coats. Therefore thermally induced strain is minimized and thermal shock resistance of the compound greatly improved. Such coatings can provide excellent long-term oxidation resistance up to 1.050 °C.

ELECTRICAL ISOLATION

In various applications special electrical characteristics of thermally sprayed coatings are utilized. Thus by the use of non conductive ceramic coatings with high dielectric strength the conduction of electric currents between technical components is prevented. In contrast other applications require the use of coatings with particularly high electrical conductivity, e.g. copper or aluminum).

THERMAL ISOLATION

Due to extreme thermal loads various components in modern technical systems have to be coated with so called thermal barrier coatings. Apart from decreased component core temperatures that result in increased life time the process efficiency can be increased at constant component core temperature, because either the operating temperature can be increased or the cooling capacity reduced.

Usually ceramics are applied as thermal barrier coating materials. Especially oxide ceramics mostly show low thermal conductivities. If the coatings are also subject to thermal cyclic loads the use of ceramics with a comparatively high coefficient of thermal expansion and thermal shock resistance is essential.

CLEARANCE CONTROL (ABRADABLE COATINGS)

Tolerances in the interaction of turning and static components have to be kept as small as possible to achieve optimum process efficiencies of e.g. power generation systems. Thus power losses can be substantially decreased by keeping close clearances, e.g. in gas turbines or screw compressors.

By combination of „abradable“ coatings, often applied upon static components, with wear resistant coatings applied to turning components, the resistant material successively grates into the abradable. Thereby a minimum clearance between the components is attained.

POWDER MORPHOLOGY

Due to the diversity of processes and spraying materials the technology of thermal spraying offers adapted solutions for a wide range of application fields. GTV offers the full spectrum of feedstock powder with different morphology, size fractions and chemical composition. Thereby the user is enabled to exploit the full potential of the thermal spray technology.
Spraying powder is available in very different size fractions and with different morphologies. Both properties take significant influence e.g. on the flowing characteristics, the melting behavior and potential micro-structural transformations during the spraying process or subsequently performed heat treatments.
The consequence of bad powder flow characteristics are fluctuations in powder feeding and thereby induced inhomogeneities in the produced coatings microstructure. Therefore, even for use of fine powder size fractions minimum flow characteristics need to be maintained.
The melting behavior has to be evaluated with regard to the desired heat transfer into the powder particles. The degree of melt formation in single particles determines e.g. the intensity of chemical reactions like oxidation or reactions of different powder constituents as well as phase transformations during spraying.
The powder particles morphology is a result of the powder production route and the applied processing. The majority of common spray powders is produced via four different routes.

FUSED OR SINTERED AND CHRUSHED POWDERS

Such powders are produced by crushing of a cast or sintered block and subsequent milling to achieve a desired particle size regime.
This procedure is mainly used for brittle materials like oxide-ceramics or carbides. The particles are characterized by a comparatively high density and a moderate melting behavior.

To manufacture multi-component powders with individual constituents side by side the raw materials are mixed and afterwards bonded by means of sintering. Finally the sintered block is crushed and milled.
Crushed powder particles show a rough, fissured surface and irregular shape (**figure 1**) which leads to rather poor flow characteristics.

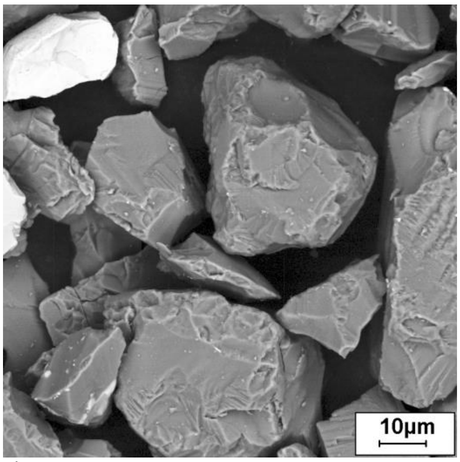

Figure 1:
Scanning electron micrograph of
a fused and crushed Al_2O_3/TiO_2 97/3 powder

WATER OR GAS ATOMIZED POWDERS

Production of atomized powders proceeds by atomization of molten material with use of adapted atomization gases either into water pool or into a vessel with adapted gas atmosphere. By choice of the atomizing gas and the atmosphere the material composition can be influenced, e.g. with concern to the powders oxygen content. Thus, the hardness of molybdenum coatings can be controlled not only by the spraying conditions, but also by the oxygen content of the powder feedstock. On the other hand the oxygen content in MCrAlY powders is kept at minimum values in order to permit spraying of coatings that will show optimized oxidation resistance.
Particles of water or gas atomized powders show a relatively low surface roughness. Water atomized particles show a more irregular geometry (**figure 2**), while gas atomized particles are nearly perfectly spherical (**figure 3**). The spherical shape greatly supports the flowing behavior. Due to the minimal surface / volume ratio of the sphere shape the heat flux into the particles and therefore the melting behavior is impeded.

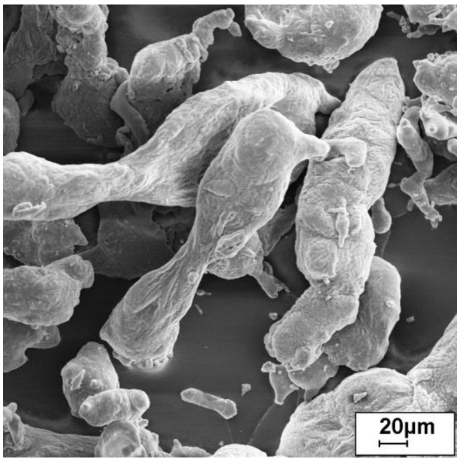

Figure 2
Scanning electron micrograph of a
water atomized aluminium powder

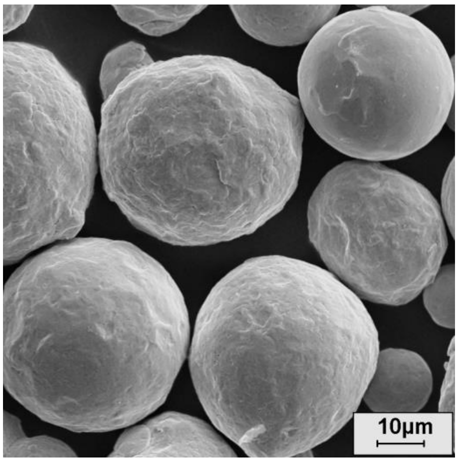

Figure 3
Scanning electron micrograph of a
gas atomized Ni20Cr powder

AGGLOMERATED AND SINTERED POWDERS

Due to a large surface / volume ratio agglomerated and sintered powders show excellent melting behavior. Their flowing characteristics are relatively good due to nearly spherical shape of most particles (**figure 4**).
Powders are produced by atomizing a suspension containing one or more material constituents as well as an organic binder into a large vessel that is kept at constant elevated temperature. Thereby spherical agglomerates are formed. The process is well established for manufacturing of cermet powders, but oxide powders are also produced. In order to avoid particle break up due to high shearing forces acting in the spray jet, in particular in the high velocity flames of HVOF guns, the agglomerates are densified in either a thermal plasma jet or in a sintering furnace. In addition, during the densification process the organic binder that would affect thermal spray coatings mechanical properties is eliminated.

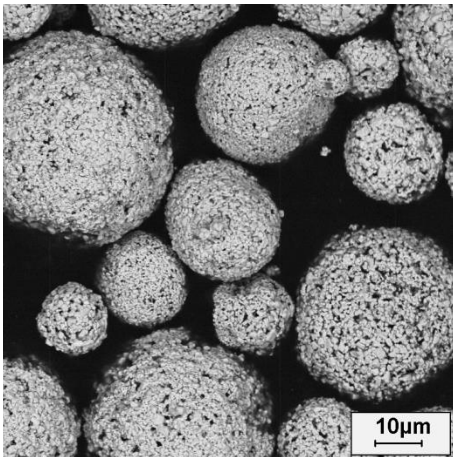

Figure 4
Scanning electron micrograph of a
agglomerated and sintered WC/Co 88/12 powder

CLAD POWDERS

To protect specific material constituents of compound powders against direct contact with the heat source of a thermal spray process or to take influence on chemical reactions of the powder constituents several powders clad.

CVD and sol gel processes are used as well as electrolytic coating processes. Furthermore adapted milling processes permit a so called mechanical cladding. Finally relatively coarse core particles are clad by fine powder particles of another constituent by use of an organic binder (**figure 5**). Like in the case of agglomerated and sintered powder the composite strength can be improved by annealing. Thereby it is important not to initiate chemical reactions that are desired to occur only in the spraying process.

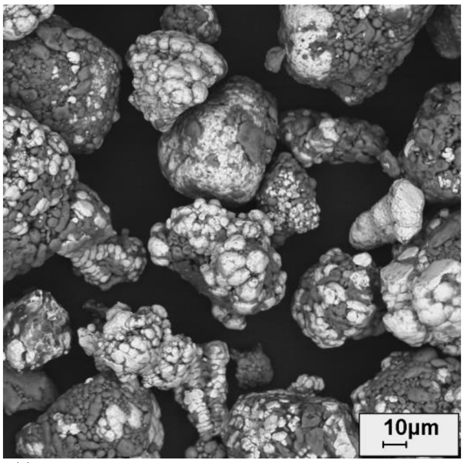

Abb. 5:
Scanning electron micrograph of an aluminium *clad* Nickel powder (Ni5Al)

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1. Metals and metallic alloys

1.1 Al: ALUMINIUM BASED MATERIALS

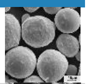
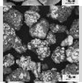
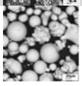
GTV No.	Description	Grain size	Spray process	Al	Fig.
30.54.1	Al water atomized	-45 +20 µm	APS	min. 99	
30.54.2	Al water atomized	-90 +45 µm	PFS	min. 99	

Characteristics / Application areas

30.54.1 / 30.54.2

- repair of aluminium and magnesium alloys
- corrosion protection for pH 5 - 8,3, even at elevated temperatures

1.2 Cu: COPPER BASED MATERIALS

GTV No.	Description	Grain size	Spray process	Al	Cu	Fig.
30.55.2	Cu water atomized	-90 +45 µm	PFS	-	min. 99	
20.45.2	Cu/Al	-90 +45 µm	PFS	10	balance	
30.51.2	Cu/Al 90/10 gas atomized	-90 +45 µm	PFS	10	balance	

Characteristics / Application areas

30.55.2

- repair of copper and copper alloys
- hardness: HB 60
- high electrical conductivity, up to 50 $S/m \cdot 10^6$
- high electrical conductivity, up to 340 $W \cdot m^{-1}K$

20.45.2

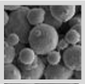
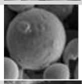
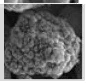
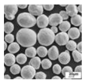
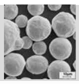
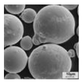
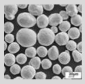
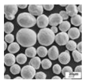
- bearing material featuring excellent gliding and dry-running operation properties
- hardness: HB 90
- „self-bonding" due to chemical reaction of components
- applicable up to approx. 230 °C

30.51.2

- bearing material featuring excellent gliding and dry-running operation properties
- repair of copper and copper alloys
- anti-fretting properties
- hardness: HB 95
- applicable up to approx. 230 °C

*The materials listed above represent a selection only.
Other grain sizes are available on request.
We ask for your detailed inquiry.

1.3 Fe: IRON BASED MATERIALS

GTV No.	Description	Grain size	Spray process	Al	Cr	Ni	C	Mo	Si	Add.	Fe	Fig.
80.91.8	FeCr13 gas atomized	-45 +15 µm	HVOF APS	-	13,5	-	<0,03	-	-	-	bal.	
80.91.8M	FeCr13 gas atomized	-45 +15 µm	HVOF APS	-	13,5	-	0,45	-	-	-	bal.	
30.42.2	FeCrNi gas atomized	-90 +45 µm	PFS APS	-	16	2	0,2	-	-	-	bal.	
20.48.2	FeAlMo clad powder	-90 +45 µm	PFS APS	10	-	-	0,2	1	-	-	bal.	
30.46.2	FeCrNiMoSi gas atomized	-106 +45 µm	PFS APS	-	17	12,5	0,1	2,5	1	-	bal.	
80.46.1	FeCrNiMoSi gas atomized	-53 +20 µm	HVOF	-	17	12,5	0,02	2,5	1	-	bal.	
81.43.1H	Iron based hard alloy gas atomized	-45 +20 µm	HVOF	-	27	16	2	4	1,5	-	bal.	
80.44.1-0	FeCrBC gas atomized	-45 +15 µm	HVOF	-	25	-	0,8	-	-	B: 5	bal.	
80.49.1	FeCrV17 gas atomized	-53 +15 µm	HVOF	-	12,5	-	3,9	0,8	0,8	V: 16,8	bal.	

Characteristics / Application areas

80.91.8
- ferritic machineable steel for repair and build-up
- hardness: HRC < 20

80.91.8
- martensitic machineable steel for repair and build-up
- hardness: HRC 34

30.42.2
- machineable steel for repair and build-up
- hardness: HRC 35
- applicable up to approx. 540 °C

20.48.2
- low shrinkage machineable steel for repair and build-up
- „self-bonding" due to chemical reaction of the components
- hardness: HRC 45
- applicable up to approx. 370 °C

30.46.2 / 80.46.1
- machineable austenitic steel for repair and build-up, similar to 316 L
- high corrosion resistance in various media
- coating hardness: 350 $HV_{0,3}$
- applicable up to approx. 540 °C

81.43.1H
- corrosion protective coatings with excellent corrosion resistance in various media
- coating hardness: 550 $HV_{0,3}$

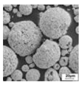
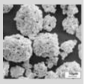
80.44.1-0

- Wear protection coating with good corrosion resistance
- Coating hardness: 900 $HV_{0,3}$

80.49.1

- Wear protection coating with good corrosion resistance
- Coating hardness: 900 $HV_{0,3}$

1.4 Mo: MOLYBDENUM BASED MATERIALS

GTV No.	Description	Grain size	Spray process	O	Ni	Cr	B	Si	Fe	Mo	Fig.
30.63.2	Mo agglomerated and sintered	-90 +45 µm	PFS APS	0,1	-	-	-	-	-	bal.	
80.63.1	Mo agglomerated and sintered	-45 +20 µm	HVOF	0,1	-	-	-	-	-	bal.	
30.05.2	Mo/NiCrBSi powder blend	-90 +45 µm	PFS	-	18	4,5	0,8	2	1	bal.	-
80.05.1	Mo/NiCrBSi powder blend	-45 +20 µm	HVOF APS	-	18	4,5	0,8	2	1	bal.	-

Characteristics / Application areas

30.63.2 / 80.63.1
- high adhesion strength due to high particle temperature and strong chemical reactivity
- high resistance against all kinds of wear stress with excellent sliding properties
- coating hardness depending on oxidation: 300 - 600 $HV_{0,3}$
- applicable up to approx. 320 °C (for excessive temperature oxidation)

30.05.2
- high resistance against all kinds of wear stress with excellent sliding properties
- hardness: HRC 55
- applicable up to approx. 320 °C (for excessive temperature oxidation)

80.05.1
- high resistance against all kinds of wear stress with excellent sliding properties
- hardness: HRC 55
- applicable up to approx. 320 °C (for excessive temperature oxidation)

1.5 Zn: ZINC BASED MATERIALS

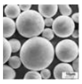
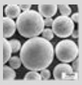
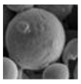
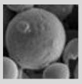
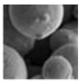
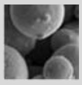
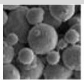
GTV No.	Description	Grain size	Spray process	Al	Fig.
30.10.2	Zn water atomized	-90 +45 µm	PFS	min. 99	

Characteristics / Application areas

30.10.2
- corrosion protection for pH 7 - 12.5, at maximum temperature of 60 °C

*The materials listed above represent a selection only.
Other grain sizes are available on request.
We ask for your detailed inquiry.

1.6 Co: COBALT BASED MATERIALS

GTV No.	Description	Grain size	Spray process	Cr	W	C	Ni	Al	Y	Co	Fig.
10.01.6	CoCrW (Stellite 1) gas atomized	-125 +45 µm	PFS APS	30	12	2,5	-	-	-	bal.	
85.01.1	CoCrW (Stellite 1) gas atomized	-53 +20 µm	HVOF	30	12	1,5	-	-	-	bal.	
15.06.6	CoCrW (Stellite 6) gas atomized	-125 +45 µm	PFS APS	28	4	1,1	-	-	-	bal.	
85.06.1	CoCrW (Stellite 6) gas atomized	-53 +22 µm	HVOF	28	4	1,1	-	-	-	bal.	
15.12.6	CoCrW (Stellite 12) gas atomized	-125 +45 µm	PFS APS	28	8	1,5	-	-	-	bal.	
85.12.1	CoCrW (Stellite 12) gas atomized	-45 +20 µm	HVOF	28	8	1,5	-	-	-	bal.	
60.95.1	CoNiCrAlY gas atomized	-53 +20 µm	HVOF VPS	21	-	-	32	8	0,5	bal.	

* Stellite is a registered trademark of *Kennametal Stellite*.

Characteristics / Application areas

10.01.6 / 85.01.1

- high resistance against all kinds of wear stress
- good sliding properties
- high impact resistance
- high hot gas corrosion and oxidation resistance
- excellent corrosion resistance in various media
- hardness: HRC 54
- applicable up to approx. 730 °C

15.06.6 / 85.06.1

- high resistance against all kinds of wear stress
- good sliding properties
- high impact resistance
- high hot gas corrosion and oxidation resistance
- excellent corrosion resistance in various media
- hardness: HRC 42

applicable up to approx. 730 °C

15.12.6 / 85.12.1

- high resistance against all kinds of wear stress
- good sliding properties
- high impact resistance
- high hot gas corrosion and oxidation resistance
- excellent corrosion resistance in various media
- hardness: HRC 48
- applicable up to approx. 730 °C

60.95.1

- repair of super alloys with comparable composition
- excellent hot gas corrosion and oxidation resistance
- excellent corrosion resistance in various media
- applicable up to approx. 1050 °C

1.7 Co: COBALT BASED MATERIALS (SELF FLUXING ALLOYS)

GTV No.	Description	Grain size	Spray process	C	Cr	Si	Ni	Fe	B	W	Mo	Co
10.18.5	SF Stellite 159 gas atomized	-106 +38 µm	PFS	0,1	18,5	3,3	27	2	3,2	-	5,5	bal.
10.18.6	SF Stellite 159 gas atomized	-125 +45 µm	PFS	0,1	18,5	3,3	27	2	3,2	-	5,5	bal.
10.06.5	SF Stellite 6 gas atomized	-106 +38 µm	PFS	0,7	19	2,5	13	<4	1,7	7,5	-	bal.
10.06.6	SF Stellite 6 gas atomized	-125 +45 µm	PFS	0,7	19	2,5	13	<4	1,7	7,5	-	bal.
80.06.1	SF Stellite 6 gas atomized	-45 +20 µm	HVOF	0,7	19	2,5	13	<4	1,7	7,5	-	bal.

* Stellite is a registered trademark of *Kennametal Stellite*.

Characteristics / Application areas

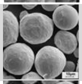
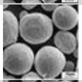
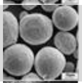
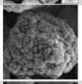
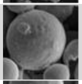
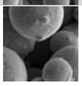
10.18.5 / 10.18.6

- high wear resistance
- high corrosion resistance in various media
- after fusion coatings are gas tight and metallurgically bonded to substrates due to diffusion
- hardness: HRC 52-56
- high hot hardness
- special suitability for ferritic and martensitic stainless steels and other base materials with low thermal expansion

10.06.5 / 10.06.6 / 80.06.1

- high wear resistance
- high corrosion resistance in various media
- after fusion coatings are gas tight and metallurgically bonded to substrates due to diffusion
- hardness: HRC 43-46
- high hot hardness

1.8 Ni: NICKEL BASED MATERIALS

GTV No.	Description	Grain size	Spray process	Cr	Al	Fe	Si	Ni	Fig.
80.56.1	Ni water atomized	-53 +15 µm	HVOF APS	-	-	-	-	99	
80.20.1	NiCr 80/20 gas atomized	-53 +20 µm	HVOF APS	20	-	-	-	bal.	
80.20.0	NiCr 80/20 gas atomized	-25 +5 µm	HVOF APS	20	-	-	-	bal.	
20.43.2	NiCr 80/20 gas atomized	-90 +45 µm	PFS	20	-	-	-	bal.	
60.43.6	NiCr 94/6 clad powder	-125 +45 µm	APS	6	-	-	-	bal.	
80.01.1	NiCrAl gas atomized	-53 +20µm	APS HVOF	18	6	-	-	bal.	
30.04.2	NiCrFe gas atomized	-90 +45µm	PFS	16	-	9	0,5	bal.	

Characteristics / Application areas

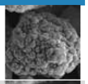
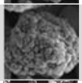
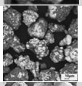
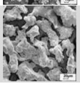
80.56.1
- machinable material for repair and build-up of nickel and nickel based alloys
- good corrosion resistance in various media

80.20.1 / 80.20.0 / 20.43.2
- excellent bond coat for ceramic top coats
- machinable material for repair and build-up
- high hot gas corrosion and oxidation resistance
- excellent corrosion resistance in various media
- coating hardness: 400 $HV_{0,3}$
- applicable up to approx. 800 °C

60.43.6
- excellent bond coat for ceramic top coats
- machinable material for repair and build-up
- high hot gas corrosion and oxidation resistance
- excellent corrosion resistance in various media
- applicable up to approx. 800 °C

80.01.1
- excellent bond coat for ceramic top coats
- machinable material for repair and build-up
- high hot gas corrosion and oxidation resistance
- excellent corrosion resistance in various media
- hardness: HRC 30
- applicable up to approx. 1000 °C

30.04.2
- excellent bond coat for ceramic top coats
- machinable material for repair and build-up
- high hot gas corrosion and oxidation resistance
- excellent corrosion resistance in various media
- applicable up to approx. 800 °C

GTV No.	Description	Grain size	Spray process	Cr	Al	Fe	Si	Mo	B	TiO_2	Ni	Fig.
20.42.2	NiCrMoAl clad powder	-90 +45µm	PFS	8,5	7	2	2	5	2	3	bal.	
20.44.2	NiCrMoAlFe clad powder	-90 +45µm	PFS	9	7	5	-	5,5	-	-	bal.	
20.50.2	NiAl 95/5 clad powder	-90 +45µm	PFS	-	5	-	-	-	-	-	bal.	
21.50.2	NiAl 95/5 water atomized	-90 +45µm	PFS	-	5	-	-	-	-	-	bal.	

Characteristics / Application areas

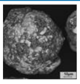
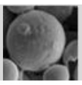
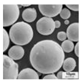
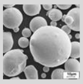
20.42.2
- material for repair and build-up with limited machinability
- high wear resistance
- good corrosion resistance in various media
- „self bonding“ due to chemical reaction of components
- hardness: HRC 35
- applicable up to approx. 750 °C

20.44.2
- excellent bond coat for ceramic top coats
- machinable material for repair and build-up
- high wear resistance
- good corrosion resistance in various media
- „self bonding“ due to chemical reaction of components
- applicable up to approx.. 1000°C

20.50.2
- machinable material for repair and build-up
- excellent bond coat for ceramic top coats with high ductility and impact resistance
- good corrosion resistance in various media
- „self bonding“ due to chemical reaction of components
- applicable up to approx. 1000°C

21.50.2
- machinable material for repair and build-up
- excellent bond coat for ceramic top coats with high ductility and impact resistance
- good corrosion resistance in various media
- applicable up to approx. 1000°C

*The materials listed above represent a selection only.
Other grain sizes are available on request.
We ask for your detailed inquiry.

GTV No.	Description	Grain size	Spritz-prozess	Al	Mo	Cr	Y	Nb	W	Fe	Ni	Fig.
20.47.2	NiAlMo clad powder	-90 +45µm	PFS APS	5,5	5	-	-	-	-	-	bal.	
60.46.8	NiCrAlY gas atomized	-38 +16µm	HVOF VPS	10	-	22	1	-	-	-	bal.	
80.25.1	NiCrMoNb (Inconel 625) gas atomized	-53 +20µm	APS	-	9	21	-	3,5	-	-	bal.	
80.93.1	NiCrMoW (Hastelloy C) gas atomized	-53 +20µm	HVOF	-	16	16	-	-	4	5,5	bal.	

*Inconel is a registered trademark of *Inco.*
*Hastelloy is a registered trademark of *Haynes International, Inc.*

Characteristics / Application areas

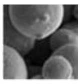
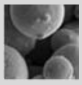
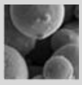
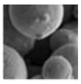
20.47.2
- machinable material for repair and build-up
- high wear resistance
- high ductility and impact resistance
- good corrosion resistance in various media
- „self bonding“ due to chemical reaction of components

60.46.8
- repair of super alloys with comparable composition
- excellent hot gas corrosion resistance
- excellent corrosion resistance in various media
- applicable up to approx. 1050 °C

80.25.1
- machineable material for repair and build-up of super alloys with comparable composition
- high wear resistance
- good hot gas corrosion resistance
- good corrosion resistance in various media
- coating hardness: 450 $HV_{0,3}$
- applicable up to approx. 800 °C

80.93.1
- machineable material for repair and build-up of super alloys with comparable composition
- high wear resistance
- good hot gas corrosion resistance
- good corrosion resistance in various media
- coating hardness: 500 $HV_{0,3}$
- applicable up to approx. 800 °C

1.9 Ni: NICKEL BASED MATERIALS (SELF FLUXING ALLOYS)

GTV No.	Description	Grain size	Spray process	Cr	B	Si	Fe	C	Ni	Fig.
10.10.5	NiBSi gas atomized HRC 22	-106 +38 µm	PFS APS	-	1,3	2,3	1	-	bal.	
10.10.6	NiBSiFe gas atomized HRC 22	-125 +45 µm	PFS APS	-	1,3	2,3	1	-	bal.	
10.11.5	NiCrBSiFe gas atomized HRC 30	-106 +38 µm	PFS APS	7	1,25	3,4	3	0,25	bal.	
10.12.6	NiCrBSiFe gas atomized HRC 40	-125 +45 µm	PFS APS	8	2,5	3,7	4	0,5	bal.	
10.14.6	NiCrBSiFe gas atomized HRC 50	-125 +45 µm	PFS APS	11	2,4	4	3	-	bal.	

Characteristics / Application areas

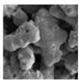
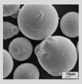
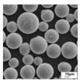
10.10.5 / 10.10.6
- high wear resistance
- good corrosion resistance in various media
- good machineability
- after fusion coatings are gas tight and metallurgically bonded to substrates due to diffusion
- hardness: HRC 22-25
- applicable up to approx. 820 °C

10.11.5
- high wear resistance
- good machineability
- after fusion coatings are gas tight and metallurgically bonded to substrates due to diffusion
- hardness: HRC 33-35
- applicable up to approx. 820 °C

10.12.6
- high wear resistance
- good corrosion resistance in various media
- good machineability
- after fusion coatings are gas tight and metallurgically bonded to substrates due to diffusion
- hardness: HRC 35-40
- applicable up to approx. 820 °C

10.14.6
- high wear resistance
- good corrosion resistance in various media
- good machineability
- after fusion coatings are gas tight and metallurgically bonded to substrates due to diffusion
- low susceptibility to cracking
- hardness: HRC 48-50
- applicable up to approx. 820 °C

*The materials listed above represent a selection only.
Other grain sizes are available on request.
We ask for your detailed inquiry.

GTV No.	Description	Grain size	Spray process	Cr	B	Si	Fe	C	Mo	Cu	Ni	Fig.
10.15.6	NiCrBSiFe water atomized HRC 60	-125 +45 µm	PFS APS	14	3,3	4,5	4,5	0,75	-	-	bal.	
10.15.6G	NiCrBSiFe gas atomized HRC 60	-125 +45 µm	PFS APS	14	3,3	4,5	4,5	0,75	-	-	bal.	
80.15.1	NiCrBSiFe gas atomized HRC 60	-53 +20 µm	HVOF	14	3,3	4,5	4,5	0,75	-	-	bal.	
10.16.6	NiCrBSiCuMo gas atomized HRC 58	-125 +45 µm	PFS APS	16	3,5	4,5	3,5	0,5	2,9	3	bal.	

Characteristics / Application areas

10.15.6 / 10.15.6G / 80.15.1

- high wear resistance
- good corrosion resistance in various media
- high impact resistance
- after fusion coatings are gas tight and metallurgically bonded to substrates due to diffusion
- hardness: HRC 60-62
- applicable up to approx. 820 °C

10.16.6

- high wear resistance
- good corrosion resistance in various media
- high impact resistance, maximum edge stability
- after fusion coatings are gas tight and metallurgically bonded to substrates due to diffusion
- hardness: HRC 58
- applicable up to approx. 820 °C

2. Cermets (Metal-Ceramic Composites)

2.1 SELF FLUXING ALLOYS WITH CARBIDE REINFORCEMENT

GTV No.	Description	Grain size	Spray process	80.15.1	80.71.1	80.77.1	10.15.6	10.71.2	10.77.2	10.81.2
80.32.1	NiCrBSi, WC/Co 88/12 powder blend	-45 +20 µm	HVOF APS	20	80	-	-	-	-	-
10.32.6	NiCrBSi, WC/Co 88/12 powder blend	-125 +45 µm	PFS APS	-	-	-	20	80	-	-
80.34.1	NiCrBSi, WC/Co 88/12 powder blend	-45 +20 µm	HVOF APS	50	50	-	-	-	-	-
10.34.5	NiCrBSi, WC/Co 88/12 powder blend	-105 +30 µm	PFS APS	-	-	-	50	50	-	-
10.34.6	NiCrBSi, WC/Co 88/12 powder blend	-125 +45 µm	PFS APS	-	-	-	50	50	-	-
80.36.1	NiCrBSi, WC/Ni 88/12 powder blend	-45 +20 µm	HVOF APS	65	-	35	-	-	-	-
10.36.6	NiCrBSi, WC/Ni 88/12 powder blend	-125 +45 µm	PFS APS	-	-	-	65	-	35	-
10.37.6	NiCrBSi, WC/Ni 88/12 powder blend	-125 +45 µm	PFS APS	-	-	-	35	-	65	-
10.59.6	NiCrBSi, Cr_2C_3/NiCr 25/75 powder blend	-125 +45 µm	PFS APS	-	-	-	25	-	-	75

Characteristics / Application areas

80.32.1 / 10.32.6
- high wear resistance
- good corrosion resistance in various media
- high impact resistance
- applicable up to approx. 540 °C

80.34.1 / 10.34.5 / 10.34.6
- high wear resistance
- good corrosion resistance in various media
- high impact resistance
- more ductile than 80.32.1 / 10.32.6
- applicable up to approx. 540 °C

80.36.1 / 10.36.6 / 10.37.6
- high wear resistance
- high impact resistance
- applicable up to approx. 540 °C

10.59.6
- high wear resistance
- good corrosion resistance in various media
- high impact resistance
- applicable up to approx. 820 °C

*The materials listed above represent a selection only.
Other grain sizes are available on request.
We ask for your detailed inquiry.

2.2 Ni: NICKEL BASED ALLOYS WITH CARBIDE REINFORCEMENT

GTV No.	Description	Grain size	Spray process	20.50.2	40.23.4	40.21.4
40.12.4	NiAl, ZrO_2/Y_2O_3 92/8 powder blend	-90 +15 µm	APS	35	65	-
40.13.4	NiAl, ZrO_2/Y_2O_3 92/8 powder blend	-90 +15 µm	APS	65	35	-
40.14.4	NiAl, ZrO_2/MgO 80/20 powder blend	-90 +15 µm	APS	35	-	65

Characteristics / Application areas

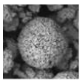
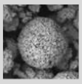
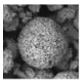
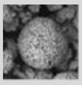
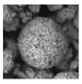
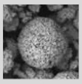
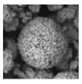
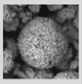
40.12.4
- high wear resistance
- good corrosion resistance in various media
- bond strength, impact and thermal shock resistance better than for pure ceramic coatings
- applicable up to approx. 800 °C

40.13.4
- high wear resistance
- bond strength, impact and thermal shock resistance better than for pure ceramic coatings
- applicable up to approx. 800 °C

40.14.4
- high wear resistance
- good corrosion resistance in various media
- bond strength, impact and thermal shock resistance better than for pure ceramic coatings
- applicable up to approx. 800 °C

*The materials listed above represent a selection only.
Other grain sizes are available on request.
We ask for your detailed inquiry.

2.3 WC: TUNGSTEN CARBIDE BASED MATERIALS

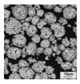
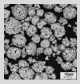
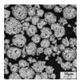
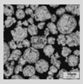
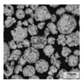
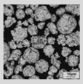
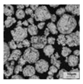
GTV No.	Description	Grain size	Spray process	Co	C	W	Fig.
80.71.0	WC/Co 88/12 agglomerated and sintered	-25 +5 µm	HVOF	12	5,5	bal.	
80.71.0X20	WC/Co 88/12 agglomerated and sintered	-20 +5 µm	HVOF	12	5,5	bal.	
80.71.1	WC/Co 88/12 agglomerated and sintered	-45 +15 µm	HVOF APS	12	5,5	bal.	
80.71.1G	WC/Co 88/12 agglomerated and sintered	-53 +20 µm	HVOF APS	12	5,5	bal.	
10.71.2	WC/Co 88/12 agglomerated and sintered	-90 +45 µm	APS	12	5,5	bal.	
80.71.3	WC/Co 88/12 agglomerated and sintered	-45 +5µm	HVOF	12	5,5	bal.	
10.71.60	WC/Co 88/12 agglomerated and sintered	-125 +90 µm	APS PFS	12	5,5	bal.	
80.71.8	WC/Co 88/12 agglomerated and sintered	-38 +10 µm	HVOF APS	12	5,5	bal.	

Characteristics / Application areas

80.71.0 / 80.71.0X20 / 80.71.1 / 80.71.1G / 10.71.2 / 80.71.3 / 10.71.60 / 80.71.8

- excellent wear resistance
- suitable for replacement of electroplated hard chromium in non-corrosive media
- coating hardness: 800-1400 $HV_{0,3}$
- applicable up to approx. 540 °C

*The materials listed above represent a selection only.
Other grain sizes are available on request.
We ask for your detailed inquiry.

GTV No.	Description	Grain size	Spray process	Co	C	Cr	Ni	W	Fig.
80.73.0	WC/Co 83/17 agglomerated and sintered	-20 +5 µm	HVOF	17	5,2	-	-	bal.	
80.73.1	WC/Co 83/17 agglomerated and sintered	-45 +15 µm	HVOF APS	17	5,2	-	-	bal.	
80.76.0	WC/Co/Cr 86/10/4 agglomerated and sintered	-25 +10 µm	HVOF	10	5,4	4	-	bal.	
80.76.1	WC/Co/Cr 86/10/4 agglomerated and sintered	-45 +15 µm	HVOF APS	10	5,4	4	-	bal.	
80.76.1G	WC/Co/Cr 86/10/4 agglomerated and sintered	-53 +20 µm	HVOF APS	10	5,4	4	-	bal.	
80.76.8	WC/Co/Cr 86/10/4 agglomerated and sintered	-38 +10 µm	HVOF APS	10	5,4	4	-	bal.	
80.78.1	WC/Co/Cr/Ni 85/10/4/1 agglomerated and sintered	-45 +15µm	HVOF APS	10	5,3	4	1	bal.	

Characteristics / Application areas

80.73. 0 / 80.73.1

- excellent wear resistance
- for adequate processing conditions higher ductility and lower hardness than 80.71
- coating hardness: 800-1300 $HV_{0,3}$
- applicable up to approx. 500 °C

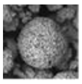
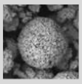
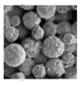
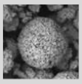
80.76.0 / 80.76.1 / 80.76.1G / 80.76.18

- excellent wear resistance
- improved corrosion resistance compared to 80.71 and 80.73
- application in various media for pH > 4 possible
- superior to electroplated hard chromium in most properties
- coating hardness: 800-1450 $HV_{0,3}$
- applicable up to approx. 500 °C

80.78.1

- excellent wear resistance
- improved corrosion resistance compared to 80.71 and 80.73
- application in various media for pH > 4 possible
- superior to electroplated hard chromium in most properties
- coating hardness: 800-1450 $HV_{0,3}$
- applicable up to approx. 500 °C

*The materials listed above represent a selection only.
Other grain sizes are available on request.
We ask for your detailed inquiry.

GTV No.	Description	Grain size	Spray process	Cr	Ni	C	W	Fig.
80.77.1	WC/Ni 88/12 agglomerated and sintered	-45 +15 µm	HVOF APS	-	12	4,2	bal.	
10.77.2	WC/Ni 88/12 agglomerated and sintered	-90 +45 µm	HVOF APS	-	12	4,2	bal.	
80.75.1	$WC/Cr_3C_2/Ni$ 73/20/7 agglomerated and sintered	-45 +15 µm	HVOF APS	21	7	5,7	bal.	
80.75.1X	$WC/Cr_3C_2/Ni$ 73/20/7 agglomerated and sintered	-45 +15 µm	HVOF APS	21	7	5,7	bal.	

Characteristics / Application areas

80.77.1 / 10.77.2

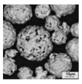
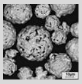
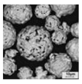
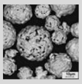
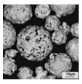
- excellent wear resistance
- improved corrosion resistance compared to 80.71 in many media
- application in various media for pH > 5 possible
- coating hardness: 800-1200 $HV_{0,3}$
- applicable up to approx. 500 °C

80.75.1X / 80.75.1

- excellent wear resistance
- improved corrosion resistance compared to 80.71 in many media
- application in various media for pH > 4 possible
- coating hardness: 800-1400 $HV_{0,3}$
- applicable up to approx. 750 °C

*The materials listed above represent a selection only.
Other grain sizes are available on request.
We ask for your detailed inquiry.

2.4 Cr_3C_2: CHROMIUM CARBIDE BASED MATERIALS

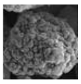
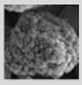
GTV No.	Description	Grain size	Spray process	Ni	C	Fe	Cr	Fig.
80.81.1X	Cr_3C_2/NiCr 75/25 agglomerated and sintered	-45 +15 µm	HVOF APS	20	10		bal.	
80.81.3	Cr_3C_2/NiCr 75/25 agglomerated and sintered	-45 +5 µm	HVOF	20	10		bal.	
80.81.8	Cr_3C_2/NiCr 75/25 agglomerated and sintered	-38 +10 µm	HVOF	20	10		bal.	
10.81.2	Cr_3C_2/NiCr 75/25 agglomerated and sintered	-90 +45 µm	PFS	20	10		bal.	
80.82.1	Cr_3C_2/FeCr 75/25 agglomerated and sintered	-45 + 15 µm	HVOF	-	10	18	bal.	

Characteristics / Application areas

80.81.1X / / 80.81.3 / 80.81.8 / 10.81.2
- excellent combined wear and corrosion resistance in various media
- coating hardness: 700-1100 $HV_{0,3}$
- applicable up to approx. 900 °C

80.82.1
- Nickel- and cobalt-free cermet coating for combined wear and corrosion protection
- Coating hardness: 850-1050 $HV_{0,3}$

2.5 GRAPHITE BASED MATERIALS

GTV No.	Description	Grain size	Spray process	Graphite	Ni	Fig.
60.08.5	Ni/Graphite 85/15 clad powder	-105 +30 µm	APS	15	bal.	
60.07.2	Ni/Graphite 75/25 clad powder	-106 +45 µm	APS	25	bal.	

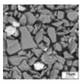
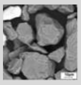
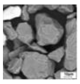
Characteristics / Application areas

60.08.5 / 60.07.2
- excellent abradable coating
- good sliding properties
- long term applicability for temperatures up to approx. 480°C

*The materials listed above represent a selection only.
Other grain sizes are available on request.
We ask for your detailed inquiry.

3. Oxide ceramics

3.1 Al_2O_3: ALUMINA BASED MATERIALS

GTV No.	Description	Grain size	Spray process	TiO_2	Al_2O_3	Fig.
40.05.0	Al_2O_3 fused and crushed	-25 +5 µm	HVOF/Gas APS	-	min. 99	
40.05.1	Al_2O_3 fused and crushed	-45 +20 µm	APS	-	min. 99	
40.01.0	Al_2O_3/TiO_2 97/3 fused and crushed	-25 +5 µm	HVOF/Gas APS	3	bal.	
40.01.1	Al_2O_3/TiO_2 97/3 fused and crushed	-45 +20 µm	APS	3	bal.	
40.01.4	Al_2O_3/TiO_2 97/3 fused and crushed	-69 +10 µm	APS	3	bal.	
40.01.8	Al_2O_3/TiO_2 97/3 fused and crushed	-40 +10 µm	APS	3	bal.	

Characteristics / Application areas

40.05.0 / 40.05.1

- high wear resistance except for fatigue load conditions
- coating hardness: 600 - 1000 $HV_{0,3}$
- applicable up to approx. 1500 °C
- excellent dielectric strength, especially at elevated temperature, up to 30 kV/mm
- electrical resistance: bis zu $3 \cdot 10^{15}$ Ωcm
- high chemical resistance except for bases

40.01.0 / 40.01.1 / 40.01.4 / 40.01.8

- high chemical resistance except for bases
- high wear resistance except for fatigue load conditions
- higher ductility than 40.05.
- lower roughness than for 40.05 possible after grinding
- coating hardness: 600 - 900 $HV_{0,3}$

*The materials listed above represent a selection only.
Other grain sizes are available on request.
We ask for your detailed inquiry.

GTV No.	Description	Grain size	Spray process	TiO_2	Al_2O_3	Fig.
40.30.0	Al_2O_3/TiO_2 87/13 fused and crushed	-22 +5 µm	HVOF/Gas APS	13	bal.	
40.30.1	Al_2O_3/TiO_2 87/13 mixed	-45 +20 µm	APS	13	bal.	
40.30.4	Al_2O_3/TiO_2 87/13 fused and crushed	-60 +30 µm	APS	13	bal.	
40.31.0	Al_2O_3/TiO_2 60/40 fused and crushed	-25 +5 µm	HVOF/Gas APS	40	bal.	
40.31.1	Al_2O_3/TiO_2 60/40 fused and crushed	-45 +20 µm	APS	40	bal.	
40.31.4	Al_2O_3/TiO_2 60/40 fused and crushed	-60 +15 µm	APS	40	bal.	
40.33.0	Al_2O_3/TiO_2 50/50 fused and crushed	-25 +5 µm	HVOF APS	50	bal.	
40.33.1	Al_2O_3/TiO_2 50/50 fused and crushed	-45 +20 µm	APS	50	bal.	
40.33.4	Al_2O_3/TiO_2 50/50 fused and crushed	-60 +15 µm	APS	50	bal.	

Characteristics / Application areas

40.30.1 / 40.30.4 / 40.30.0

- high chemical resistance except for bases
- high wear resistance except for fatigue load conditions
- higher ductility than 40.01
- lower roughness than for 40.01 possible after grinding (Ra = 0,2 µm)
- coating hardness: 500-800 $HV_{0,3}$
- applicable up to approx. 550 °C
- low wettability

40.31.1 / 40.31.0 / 40.31.4

- lower chemical resistance than 40.01
- high wear resistance except for fatigue load conditions
- higher ductility than 40.30
- lower roughness than for 40.30 possible after grinding (Ra = 0,2 µm)
- coating hardness: 400-800 $HV_{0,3}$
- applicable up to approx. 550 °C
- low wettability

40.33.0 / 40.33.1 / 40.33.4

- lower chemical resistance than 40.01
- high wear resistance except for fatigue load conditions
- higher ductility than 40.31
- lower roughness than for 40.31 possible after grinding
- coating hardness: 400-800 $HV_{0,3}$
- applicable up to approx. 550 °C
- low wettability

*The materials listed above represent a selection only.
Other grain sizes are available on request.
We ask for your detailed inquiry.

GTV No.	Description	Grain size	Spray process	ZrO_2	MgO	TiO_2	Al_2O_3	Fig.
40.28.1	Al_2O_3/ZrO_2 60/40 fused and crushed	-45 +20 µm	APS	40	-	-	bal.	
40.70.1	Al_2O_3/MgO 72/28 fused and crushed	-45 +20 µm	APS	-	28	-	bal.	

Characteristics / Application areas

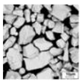
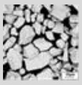
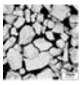
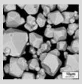
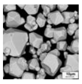
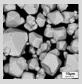
40.28.1

- high wear resistance except for fatigue load conditions
- coating hardness: 500-800 $HV_{0,3}$
- applicable up to approx. 1300 °C

40.70.1

- high wear resistance except for fatigue load conditions
- coating hardness: 500-900 $HV_{0,3}$
- applicable up to approx. 900 °C
- thermal conductivity to minimum 1,5 W/m·K

3.2 Cr_2O_3: CHROMIA BASED MATERIALS

GTV No.	Description	Grain size	Spray process	Cr_2O_3	Fig.
40.06.0	Cr_2O_3 fused and crushed	-25 +5 µm	HVOF/Gas APS	min. 99	
40.06.1	Cr_2O_3 fused and crushed	-45 +20 µm	APS	min. 99	
40.06.4	Cr_2O_3 fused and crushed	-60 +20 µm	APS	min. 99	
41.06.0	Cr_2O_3 sintered and crushed	-25 +5 µm	HVOF/Gas APS	min. 99,7	
41.06.1	Cr_2O_3 sintered and crushed	-45 +20 µm	APS	min. 99,6	
41.06.8	Cr_2O_3 sintered and crushed	-38 +15 µm	APS	min. 99,6	

Characteristics / Application areas

40.06.0 / 40.06.1 / 40.06.4

- high chemical resistance for all pH values
- high wear resistance except for fatigue load conditions
- coating hardness: up to 1500 $HV_{0,3}$
- applicable up to approx. 540 °C
- low roughness possible after grinding (R_a = 0,1 µm)
- electrical resistance: 10^7 Ωcm

41.06.0 / 41.06.1 / 41.06.8

- high chemical resistance for all pH values
- high wear resistance except for fatigue load conditions
- coating hardness: up to 1500 $HV_{0,3}$
- applicable up to approx. 540 °C
- low roughness possible after grinding (R_a = 0,1 µm)
- higher purity than 40.06
- metal free, therefore laser engraving possible

*The materials listed above represent a selection only.
Other grain sizes are available on request.
We ask for your detailed inquiry.

GTV No.	Description	Grain size	Spray process	TiO_2	SiO_2	Cr_2O_3	Fig.
40.60.1	Cr_2O_3/TiO_2 60/40 mixed powder	-45 +20 µm	APS	40	-	bal.	
40.36.0	$Cr_2O_3/SiO_2/TiO_2$ 92/5/3 fused and crushed	-25 +5 µm	APS	3	5	bal.	
40.36.1	$Cr_2O_3/SiO_2/TiO_2$ 92/5/3 fused and crushed	-45 +20 µm	APS	3	5	bal.	

Characteristics / Application areas

40.60.1

- high wear resistance except for fatigue load conditions
- improved ductility compared to pure Cr_2O_3 coatings
- coating harndess: up to 1000 $HV_{0,3}$
- applicable up to approx. 540 °C
- low roughness possible after grinding

40.36.1 / 40.36.0

- high chemical resistance for all pH values
- high wear resistance except for fatigue load conditions
- more impact resistant than pure Cr_2O_3 coatings
- coating hardness: up to 1200 $HV_{0,3}$
- applicable up to approx. 540 °C

3.3 TiO_2: TITANIA BASED MATERIALS

GTV No.	Description	Grain size	Spray process	TiO_2.	Fig.
40.02.1	TiO_2 fused and crushed	-45 +20 µm	APS	min. 97	

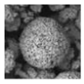
Characteristics / Application areas

40.02.1

- good wear resistance (however, lower compared to alumina or chromia based coatings) except for fatigue load conditions
- improved ductility compared to Cr_2O_3 coatings
- hardness: $HV_{0,3}$ 650
- applicable up to about approx. 500 °C
- antistatic

*The materials listed above represent a selection only.
Other grain sizes are available on request.
We ask for your detailed inquiry.

3.4 ZrO_2: ZIRCONIA BASED MATERIALS

GTV No.	Description	Grain size	Spray process	Y_2O_3	MgO	CaO	ZrO_2	Fig.
40.23.1	ZrO_2/Y_2O_3 92/8 fused and crushed	-45 +20 µm	APS	8	-	-	bal.	
40.23.4	ZrO_2/Y_2O_3 92/8 fused and crushed	-60 +10 µm	APS	8	-	-	bal.	
40.23.5N	ZrO_2/Y_2O_3 92/8 agglomerated and sintered	-100 +44 µm	APS	8	-	-	bal.	
40.24.1	ZrO_2/Y_2O_3 87/13 fused and crushed	-45 +20 µm	APS	13	-	-	bal.	
40.29.1	ZrO2/MgO 80/20 fused and crushed	-45 +20 µm	APS	-	20	-	bal.	

Characteristics / Application areas

40.23.1 / 40.23.4 / 40.23.5N

- optimum coating material for heat insulation due to low thermal conductivity and excellent thermal shock resistance
- low thermal expansion mismatch to super alloys (11 10^{-6} K^{-1})
- coating hardness: max. 700 $HV_{0,3}$
- in combination with MCrAlY bond coats on super alloys long term applicability for surface temperatures up 1250 °C
- suitable for clearance control

40.29.1

- low thermal conductivity
- high thermal shock resistance, but inferior to 40.23
- coating hardness: max. 700 $HV_{0,3}$
- applicable up to approx. 900 °C
- good running characteristics

40.24.1

- low thermal conductivity
- high thermal shock resistance, but inferior to 40.23
- coating hardness: max. 700 $HV_{0,3}$
- applicable up to approx. 1150 °C
- suitable for clearance control

*The materials listed above represent a selection only.
Other grain sizes are available on request.
We ask for your detailed inquiry.

GTV No.	Description	Grain size	Spray process	Y_2O_3	MgO	CaO	ZrO_2	Fig.
40.21.1	ZrO_2/MgO 80/20 fused and crushed	-45 +20 µm	APS	-	22	-	bal.	
40.20.1	ZrO_2/CaO 95/5 fused and crushed	-45 +20 µm	APS	-	-	5	bal.	
40.26.1	ZrO_2/CaO 70/30 fused and crushed	-45 +20 µm	APS	-	-	30	bal.	

Characteristics / Application areas

40.21.1
- low thermal conductivity
- high thermal shock resistance, but inferior to 40.23.
- coating hardness: max. 700 $HV_{0,3}$
- applicable up to approx. 900 °C
- suitable for clearance control

40.20.1
- low thermal conductivity
- high thermal shock resistance, but inferior to 40.23.
- coating hardness: max. 700 HV0,3
- applicable up to approx. 900 °C
- suitable for clearance control

40.26.1
- low thermal conductivity
- high thermal shock resistance, but inferior to 40.23.
- applicable up to approx. 900 °C
- coating hardness: max. 700 $HV_{0,3}$
- suitable for clearance control

*The materials listed above represent a selection only.
Other grain sizes are available on request.
We ask for your detailed inquiry.