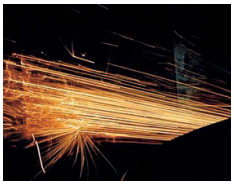
January 2009

surface engineering

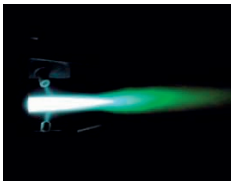
TeroCoating®

TeroCoating® – TLS 241
Chrome steels
FeCrC



Iron-based compounds of varying chromium content. Applied by arc spray processes resulting in dense and homogenous coatings of medium to high hardness. Used for protecting functional surfaces of components against mechanical wear. With good resistance to abrasion, particle erosion and impact wear at limited corrosion resistance. Frequently used for repairs. The coatings can be finished mechanically by turning.

TeroCoating® – TLS 324
Aluminium oxide –
titanium dioxide Al_2O_3-TiO_2



Applied by plasma spraying to protect functional surfaces against wear and corrosion. These homogenous and dense oxide-ceramic coatings possess good resistance when exposed to acidic and alkaline solutions and can be further augmented by sealing technologies. A wide variety of applications are possible owing both to the coating's specific chemical-physical properties and to its diversity of mechanical finishes for obtaining specific surface conditions. Titanium oxide increases toughness and improves resistance to thermocyclic strain. Increased content of TiO improves mechanical workability but reduces electrical insulation and resistance to abrasion.

TeroCoating® – TLS 334
Chromium oxide
Cr_2O_3

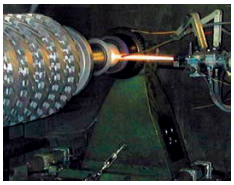
Protects metallic functional surfaces from wear and corrosion. This ultra-pure protective coating is applied by plasma spraying and has very good resistance properties to acidic and alkaline solutions. Employed for heavy-duty sealing seats due to its excellent dynamic friction properties. The diversity in applications results both from particular chemical-physical properties and from various mechanical finishes for obtaining specific surface conditions.

surface engineering

TeroCoating® – TLS 415
Chromium carbide
Cr_3C_2 - NiCr

Consists of a hard-metallic structure with a chromium carbide content of 75 % by volume, embedded in a metallic matrix of nickel and chromium. Applied by high-velocity flame spraying processes leading to ultra-hard and homogenous coatings of the highest density for protecting functional surfaces of components against mechanical wear and chemical corrosion attacks. Chromium carbides excel in high chemical and thermal stability. Embedding these in a non-corrosive and non-oxidising matrix of nickel and chromium results in wear-resistant coatings particularly suited for high temperature applications which have stood the test in the chemical and aviation industries in many cases. The hardness of such coatings is superior to those of electroplated hard chromium. The diversity in applications results both from particular chemical-physical properties and from various mechanical finishes for obtaining specific surface conditions.

TeroCoating® – TLS 425
Tungsten carbide
WC-Co, WC-CoCr



Consists of a hard-metallic structure with a tungsten carbide content of above 80 % by weight, embedded in a metallic matrix of cobalt or cobalt and chromium. Applied by high-velocity flame spraying processes leading to ultra-hard and homogenous coatings of the highest density for protecting functional surfaces of components against mechanical wear and corrosion. The hardness of such coatings is far superior to those of electroplated hard chromium. The diversity in applications results both from particular chemical-physical properties and from various mechanical finishes for obtaining specific surface conditions.

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surface engineering

TeroCoating® – TLS 241
Chrome steels, FeCrC

TeroCoating® TLS 241

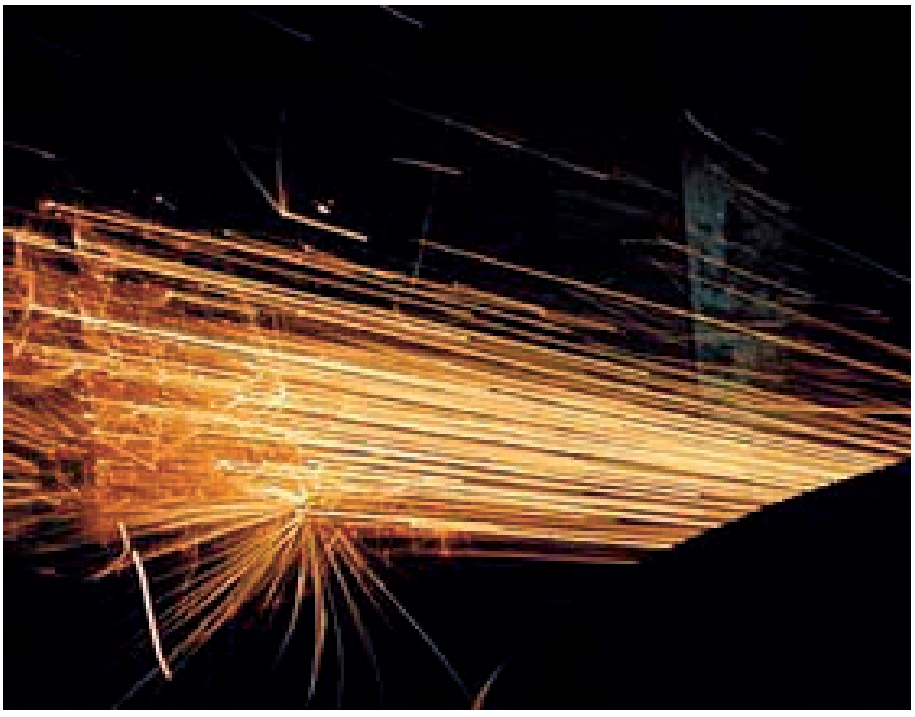
- are iron-based compounds of varying chromium content. Applied by arc spray processes resulting in dense and homogenous coatings of medium to high hardness. Used for protecting functional surfaces of components against mechanical wear. Especially suited for protecting surfaces with limited resistance to abrasion, particle erosion and impact wear. Frequently used for repair coatings. The coatings can be finished mechanically by turning.
- can be applied on metallic, ceramic and synthetic or on fibre-reinforced components. The components' temperature during coating processes is generally between 50 °C and 200 °C.

Profile of properties

Wear resistance:	Medium hardness and homogenous layer composition results in good resistance against abrasive wear and very good resistance against impact wear.
Chemical resistance:	Limited to good resistance in watery media
Roughness:	Medium to high roughness particularly suited for functional surfaces with transport and entrainment characteristics.
On-site coating:	Certain applications are practicable as on-site coatings at our customers'.

Examples of use

- Piston rods
- Bearing seats
- Bushings
- Boilers
- Fans



TeroCoating® – TLS 241
Aciers au chrome, FeCrC

surface engineering

General coating characteristics

Composition	FeCrC; FeCrBSi
Hardness	300–1350 HV0,1
Coating thickness (av.)	0.3–1.5 mm
Roughness (av.)	60–100 µm R_z
Porosity (av.)	1–6 %
Bond strength EN 582	> 40 MPa
Operating temperature	< 500 °C

Variants + coating characteristics

Variant	Composition [%/weight]	Hardness [HV 0,1]	Av. roughness, sprayed [µm]	Specific application areas
TeroCoating® TLS 241.202	Fe: bal. Cr: 13 C: 0,4	300–400	70–100	Wear-resistant coating of medium hardness for general mechanical parts, limited resistance to corrosion, turnable steel repair parts.
TeroCoating® TLS 241.204	Fe: bal. Cr: 17 C: 0,4	350–450	70–100	As 241.202 but increased resistance to corrosion.
TeroCoating® TLS 241.206	Fe: bal. Cr: 29 B: 3.7 Si: 1.6	850–1350	60–80	Cold hardening wear-resistant coating with high hardness against abrasion, particle erosion, and impact wear with low friction coefficient.

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surface engineering

TeroCoating® – TLS 324
Aluminium oxide – titanium dioxide, Al_2O_3-TiO_2

TeroCoating® TLS 324

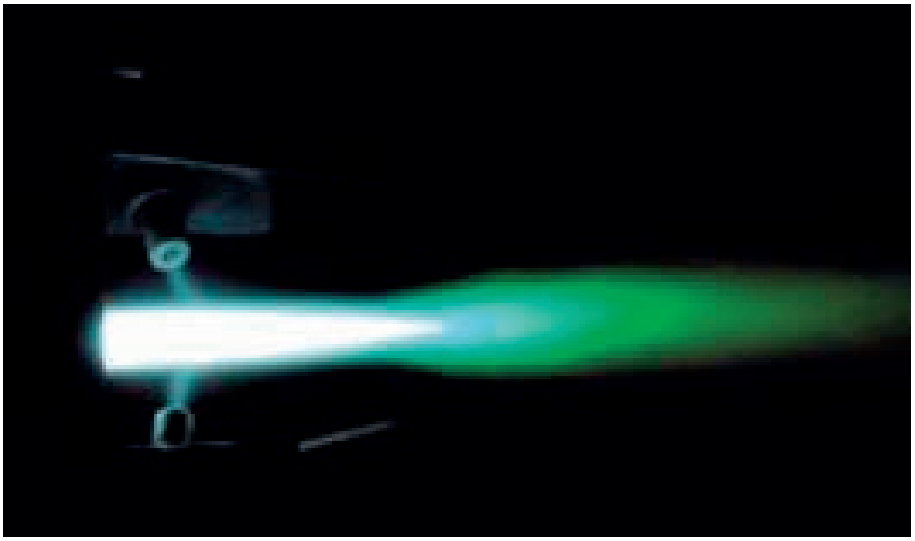
- protects functional surfaces of mechanical parts against wear and corrosion. Applied by plasma spraying resulting in homogenous and dense oxide-ceramic coatings possessing good resistance when exposed to acidic and alkaline solutions and can be further augmented by sealing technologies. A wide variety of applications are possible owing both to the coating's specific chemical-physical properties and to its diversity of mechanical finishes for obtaining specific surface conditions. Titanium oxide toughens viscosity and boosts resistance to thermocyclic strain. Increased content of TiO improves mechanical workability but reduces electrical insulation and resistance to abrasion.
- can be applied to metallic, ceramic and synthetic based or fibre-reinforced parts. The parts' temperature during coating processes is generally between 50 °C and 200 °C

Profile of properties

Wear resistance:	Hard and tough and homogenous layer composition results in excellent resistance against abrasive wear, erosion and cavitation.
Chemical resistance:	This high-purity and dense oxide-ceramic protective layer possesses good resistance in acidic and alkaline solutions.
Heat and oxidation resistance:	Good to very good resistance to operational temperatures of up to 1100 °C.
Expansion tolerance	Toughness increases with rising proportion of TiO_2 compared to pure Al_2O_3 coatings, leading to favourable temperature cycle behaviour.
Thread protection:	Surface topography variably adjustable, allowing for application on many thread-carrying components in textile machining.
Electric insulation:	Good dielectrical properties, decreasing with rising TiO_2 content.

Examples of use

- Thread guides
- Godets, grooved rollers
- Guide rollers
- Plungers
- Shaft protection sleeves



TeroCoating® – TLS 324
Oxydes d'aluminium – oxyde de titane, Al_2O_3-TiO_2

surface engineering

General coating characteristics

Composition	Al_2O_3: 97…60 %/weight TiO_2: 3…40 %/weight
Hardness	700–1350 HV0,1
Coating thickness (av.)	100–350 µm
Roughness (av.)	2.5–4.0 µm R_a
Porosity (av.)	1–5 %
Bond strength EN 582	> 30 MPa
Operating temperature	< 550…1100 °C

Variants + coating characteristics

Variant	Composition [Vol.-%]	Hardness [HV 0,1]	Roughness [µm]	Expansion [1/K]	Specific application areas
TeroCoating® TLS 324.003	Al_2O_3: 97 TiO_2: 3	1150–1350	R_z = 29 R_a = 4.8	$8 \cdot 10^{-6}$	up to 1100 °C high electric insulation; high wear resistance.
TeroCoating® TLS 324.004	Al_2O_3: 97 TiO_2: 3	1150–1350	R_z = 21 R_a = 3.6	$8 \cdot 10^{-6}$	
TeroCoating® TLS 324.005	Al_2O_3: 87 TiO_2: 13	950–1200	R_z = 31 R_a = 5.1	$5 \cdot 10^{-6}$	up to 550 °C high wear resistance with good toughness.
TeroCoating® TLS 324.007	Al_2O_3: 87 TiO_2: 13	950–1200	R_z = 22 R_a = 3,7	$5 \cdot 10^{-6}$	
TeroCoating® TLS 324.009	Al_2O_3: 60 TiO_2: 40	700–1000	R_z = 35 R_a = 5.9	$4 \cdot 10^{-6}$	up to 550 °C high temperature change stability.
TeroCoating® TLS 324.012	Al_2O_3: 60 TiO_2: 40	700–1000	R_z = 25 R_a = 4.2	$4 \cdot 10^{-6}$	

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January 2009

surface engineering

TeroCoating® – TLS 334
Chromium dioxide, Cr_2O_3

TeroCoating® TLS 334

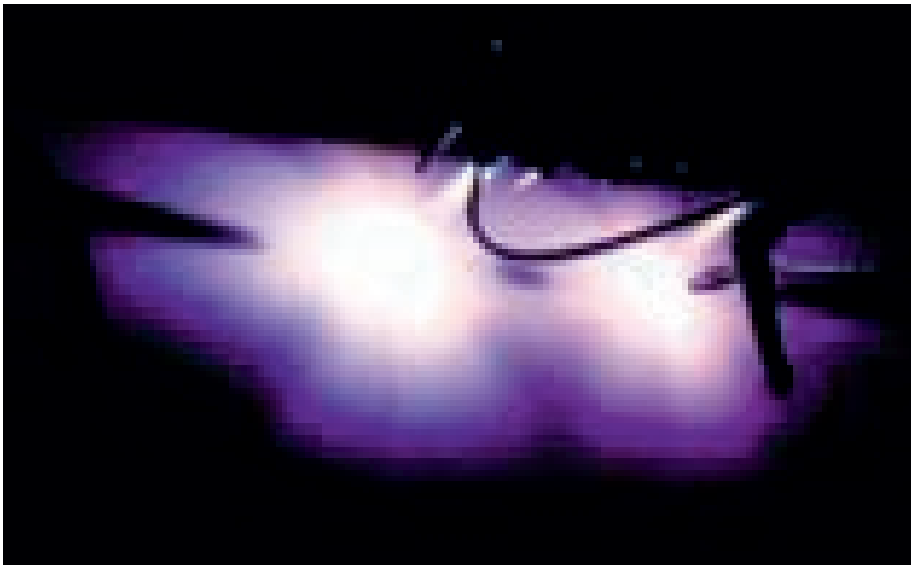
- protects metallic functional surfaces of mechanical parts against wear and corrosion. Applied by plasma spraying resulting in ultra-pure and dense oxide-ceramic coatings possessing very good resistance when exposed to acidic and alkaline solutions. Employed for the most demanding heavy-duty sealing seats due to its excellent dynamic friction properties. The diversity in applications results both from particular chemical-physical properties and various mechanical finishes for obtaining specific surface conditions.
- can be applied to metallic, ceramic and synthetic based or fibre-reinforced parts with or without an intermediate layer. The parts' temperature during coating processes is generally between 50 °C and 200 °C.

Profile of properties

Wear resistance:	High degree of hardness and homogenous layer composition result in excellent wear resistance which has been proven with many applications, e.g. on thread-carrying parts in textile machining.
Chemical resistance:	This high-purity and dense oxide-ceramic protective layer possesses very good resistance in acidic and alkaline solutions.
Friction and gliding resistance:	Outstanding gliding and friction properties make this coating an ideal technical solution for sealing seats on general mechanical parts.
Laser engravability:	Optimally suited for laser engravings with CO_2 or YAG lasers for surface texturing in the printing and packaging industries.
Ink absorption properties:	Favourable chemical surface properties allow for optimum uptake and release of water-based inks in the printing industry.

Examples of use

- Ring bearings
- Shaft protection sleeves
- Piston shafts, Plungers
- Ink ductors, Anilox rollers



TeroCoating® – TLS 334
Oxyde de chrome, Cr_2O_3

surface engineering

Coating characteristics

Composition	Cr_2O_3, >99.5 %/weight
Hardness	1500–1900 HV0,1
Coating thickness (av.)	150–300 µm
Roughness (av.)	2.5–4.0 µm R_a
Porosity (av.)	2–4 %
Bond strength EN 582	> 30 MPa
Operating temperature	< 500 °C
Friction coefficient	0.20–0.33 (vs. graphite)
Young's modulus	$1.05 \cdot 10^5$ N/mm^2
Elongation at fracture	< 0.1 %
Fracture toughness	267 N/mm^2
Thermal expansion	$6.7 \cdot 10^{-6}$ 1/K
Thermal conductivity	10 W/mK, at 1000 °C
Specific heat	0.86 J/gK, at 1000 °C

Variants

Variant	Av. roughness, sprayed [µm]	Min. roughness, finished [µm]
TeroCoating® TLS 334.015	R_z = 25 R_a = 3.8	R_z = 1.5 R_a = 0.08
TeroCoating® TLS 334.014	R_z = 15 R_a = 2.5	R_z = 1 R_a = 0.05
TeroCoating® TLS 334.019	R_z = 12 R_a = 1.9	R_z = 0.7 R_a = 0.03

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surface engineering

TeroCoating® – TLS 425
Tungsten carbide, WC-Co, WC-CoCr

TeroCoating® TLS 425

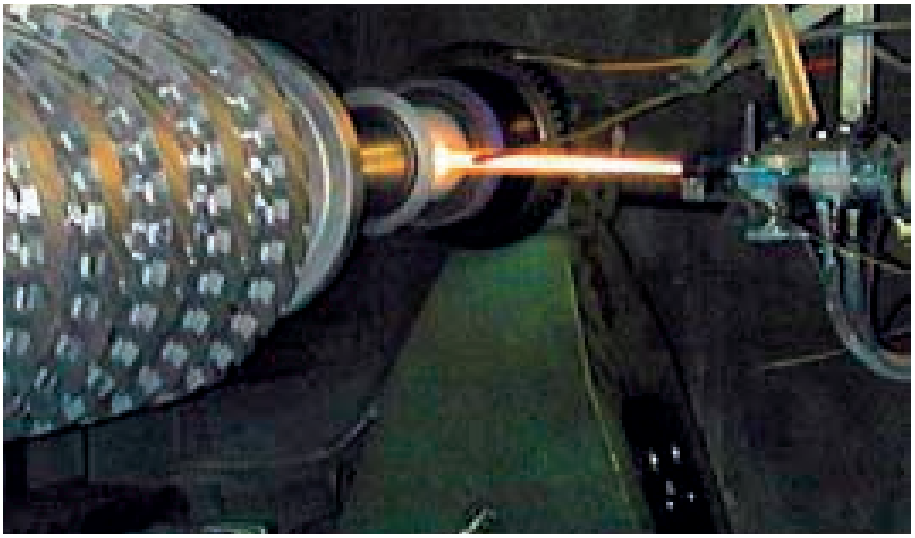
- consists of a hard-metallic structure with a tungsten carbide content of above 80 % by weight, embedded in a metallic matrix of cobalt or cobalt and chromium. Applied by high-velocity flame spraying processes leading to ultra-hard and homogenous coatings of the highest density for protecting functional surfaces of components against mechanical wear and corrosion. The hardness of such coatings is far superior to those of electroplated hard chromium. The diversity in applications results both from particular chemical-physical properties and various mechanical finishes for obtaining specific surface conditions.
- can be applied to metallic, ceramic and synthetic based or fibre-reinforced parts with and without intermediate layer. The parts' temperature during coating processes is generally below 200 °C.

Profile of properties

Wear resistance:	Extreme hardness and homogenous layer composition result in highest resistance against abrasive, adhesive and erosive wear.
Hardness:	High tungsten carbide contents form layers with hard-metallic microstructure and extreme hardness.
Chemical resistance:	This dense carbidic protective coating possesses good chemical resistance particularly in neutral and acidic solutions as well as in salt water.
Roughness:	Fine carbides as well as the dense and homogenous layer composition allow for the formation of smooth surfaces which achieve high gloss quality when mechanically finished.
Bond strength:	High particle velocity and the coating material's composition provide bond strength > 85 MPa.

Examples of use

- Paper rollers
- Pump housings and plungers
- Off-shore components
- Compressor blades
- Rotary valves



Reg.-Nr. 237-02 ISO 9001:2000 Certificat : 01 100 047034 ISO 13485:2003 Certificat : 01 105 047034

surface engineering

TeroCoating® – TLS 425
Tungsten carbide, WC-Co, WC-CoCr

Coating characteristics

Composition	WC-Co; WC-CoCr
Hardness	1250–1650 HV0,1
Coating thickness (av.)	50–250 µm
Roughness (av.)	2.0–4.5 µm R_a
Porosity (av.)	0.25–1 %
Bond strength EN 582	> 85 MPa
Operating temperature	< 500 °C
Density	13.5–14.2 g/cm^3
Friction coefficient vs. steel, dry	µ = 0.54
Thermal conductivity	81.0–84.0 W/mK
Specific heat	0.29 J/gK (at 500 °C)

Variants + coating characteristics

Variant	Composition [%/vol.]	Hardness [HV 0,1]	Av. roughness [µm]	Min. roughness [µm]	Specific application areas
TeroCoating® TLS 425.051	WC: 88 Co: 12	1350–1650	R_z = 29 R_a = 4.5	R_z = 0.12 R_a = 0.02	degree of hardness; resistant against abrasive and erosive wear
TeroCoating® TLS 425.053	WC: 88 Co: 12	1350–1650	R_z = 16 R_a = 2.5	R_z = 0.08 R_a = 0.008	
TeroCoating® TLS 425.054	WC: 83 Co: 17	1250–1550	R_z = 24 R_a = 4.2	R_z = 0.10 R_a = 0.005	as TLS 425.051 + .053 but with improved toughness
TeroCoating® TLS 425.052	WC: 83 Co: 17	1250–1550	R_z = 14 R_a = 2.1	R_z = 0.05 R_a = 0.005	
TeroCoating® TLS 425.055	WC: 86 Co-Cr: 10–14	1250–1550	R_z = 22.5 R_a = 3.8	R_z = 0.10 R_a = 0.01	as TLS 425.051 + .053 but with considerably improved corrosion resistance
TeroCoating® TLS 425.056	WC: 86 Co-Cr: 10–14	1250–1550	R_z = 15 R_a = 2.2	R_z = 0.05 R_a = 0.005	

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surface engineering

TeroCoating® – TLS 415
Chromium Carbide, Cr_3C_2-NiCr

TeroCoating® TLS 415

- consists of a hard-metallic structure with a chromium carbide content of 75 % by volume, embedded in a metallic matrix of nickel and chromium. Applied by high-velocity flame spraying processes leading to ultra-hard and homogenous coatings of the highest density for protecting functional surfaces of components against mechanical wear and chemical corrosion attacks. Chromium carbides excel in high chemical and thermal stability. Embedding these in a non-corrosive and non-oxidising matrix of nickel and chromium results in wear-resistant coatings particularly suited for high temperature applications which have stood the test in the chemical and aviation industries in many cases. The hardness of such coatings is superior to those of electro-plated hard chromium. The diversity in applications results both from particular chemical-physical properties and various mechanical finishes for obtaining specific surface conditions.
- can be applied to metallic, ceramic and synthetic based or fibre-reinforced parts with and without intermediate layer. The parts' temperature during coating processes is generally below 200 °C.

Profile of properties

Wear resistance:	High contents in carbide and homogenous layer composition result in excellent resistance against abrasion, cavitation and erosion.
Chemical resistance:	Outmost chemical stability of the coating's constituents and dense structural composition provide very good resistance in acidic and alkaline media.
Friction and gliding resistance:	Outstanding gliding and friction properties make this coating an ideal technical solution for sealing seats on general mechanical parts exposed to extreme strain.
Hot gas resistance:	High thermal stability of the coating's components allows for oxidation-resistant operation up to 870 °C.
Anti-fretting:	Micro-structural composition and low surface energy ensure high resistance against fretting, especially at raised temperatures.

Examples of use

- Pump plungers and housings
- Shaft sealing seats
- Ball valves
- Hydraulic valves
- Drying cylinders

TeroCoating® – TLS 415
Chromium Carbide, Cr_3C_2-NiCr

surface engineering

Coating characteristics

Composition	Cr_3C_2-NiCr 75/25
Hardness	1000–1300 HV0,1
Coating thickness (av.)	150–300 µm
Roughness (av.)	2.5–4.0 µm R_a
Porosity (av.)	0.5–2 %
Bond strength EN 582	> 80 MPa
Operating temperature	< 870 °C
Density	6.3 g/cm²
Young's modulus	1.22 · 10^5 N/mm²
Elongation at fracture	< 0.1 %
Thermal expansion	10.0 · 10^6 1/K
Specific heat	0.67 J/gK, at 870 °C

Variants + coating characteristics

Variants	Av. roughness, sprayed [µm]	Min. roughness, finished [µm]
TeroCoating® TLS 415.060	R_z = 25 R_a = 3.8	R_z = 1.5 R_a = 0.08
TeroCoating® TLS 415.061	R_z = 15 R_a = 2.5	R_z = 1 R_a = 0.05

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