Composition of the materials

Implants

The implants are made of Gr. 4 commercially pure titanium, in compliance with harmonized standards. Although very rare, titanium allergy is possible. Patients should therefore always be asked whether they have allergies of this type.
The characteristics of the Gr. 4 titanium used are listed below.

Grade 4 titanium (Cold worked)*

chemical composition	maximum allowed values (%)	tolerance
nitrogen	0.05	+/- 0.02
carbon	0.10	+/- 0.02
hydrogeno	0.015	+/- 0.002
iron	0.25	+/- 0.10 (%<0.25) +/- 0.15 (%>0.25)
oxygen	0.20	+/- 0.02 (%<0.20) +/- 0.03 (%>0.20)
titanium	remainder	-

** This technical information complies with the express specifications of the regulations in force on the use of Gr. 4 titanium in implantology:*
- *ASTM F67 current edition*
- *ISO 5832-2 current edition*

Surgical instruments

Depending on the type of component, surgical instruments are made of:
- Gr. 5 titanium
- 1.4197 steel
- 1.4542 steel
- 1.4305 (AISI 630) steel
- 1.4108 (AISI 303) steel
- 1.4108 steel
- 1.4112 steel

Patients must be asked if they are allergic to any of the materials used.

Prosthetic components

Gr. 2 titanium*

chemical composition	maximum allowed values (%)	tolerance
nitrogen	0.03	+/- 0.02
carbon	0.08	+/- 0.02
hydrogen	0.015	+/- 0.002
iron	0.30	+/- 0.10 (%<0.25) +/- 0.15 (%>0.25)
oxygen	0.25	+/- 0.02 (%<0.20) +/- 0.03 (%>0.20)
titanium	remainder	-

** This technical information complies with the express specifications of the regulations in force on the use of titanium Gr. 2 in implantology:*

- *ASTM F67 current edition*
- *ISO 5832-2 current edition*

Gr. 5 titanium*

chemical composition	maximum allowed values (%)	tolerance
nitrogen	0.05	+/- 0.02
carbon	0.08	+/- 0.02
hydrogen	0.012	+/- 0.002
iron	0.25	+/- 0.10
oxygen	0.13	+/- 0.02
aluminium	5.5÷6.5	+/- 0.40
vanadium	3.5÷4.5	+/- 0.15
titanium	remainder	-

** This technical information complies with the express specifications of the regulations in force on the use of Gr. 5 titanium in implantology:*

- *ASTM F136 current edition*
- *ISO 5832-3 current edition*

REEF resin

REEF resin	
description	acrylic material resistant to bacterial colonization
colour	translucent white

physical and mechanical properties	
hardness (ASTMD92/ISO 6507)	17.5 +/- 0.5 Vickers
tensile strength	28.3 +/- 3.8 Mpa
compressive strength (ASTM D3410)	404.2 +/- 22 Mpa
bending strength (ASTM D790M)	67.5 +/- 15.3 Mpa

PEEK

PEEK	
description	polyether ether ketonee
colour	opaque white cream

physical and mechanical properties	
density	1.4 g/cm^3
modulus of elasticity in tension (DIN EN ISO 527-2)	4700 MPa
yield strength (DIN EN ISO 527-2)	117 MPa
elongation to yield (DIN EN ISO 527-2)	5 %
elongation at break (DIN EN ISO 527-2)	11 %
flexural strength (DIN EN ISO 178)	177 MPa
modulus of flexural elasticity (DIN EN ISO 178)	4400 MPa
modulus of compressibility (EN ISO 604)	3500 MPa

thermal properties	
glass transition temperature	150 °C
maximum temperature for short-term use	300 °C
maximum temperature for continuous use	260 °C

chemical properties	
absorption at 23°C in 24/96 hours (DIN EN ISO 62)	0.02/0.03%

PMMA

PMMA	
chemical designation	polymethylmethacrylate
colour	transparent

physical and mechanical properties	
density	1.19 g/cm^3
yield strength (DIN EN ISO 527-2)	80 MPa
elongation at break (DIN EN ISO 527-2)	5.5 %
modulus of elasticity in tension (DIN EN ISO 527-2)	3300 MPa
hardness ball falling (ISO 2039-1)	175 MPa
impact strength (Charpy) (DIN EN ISO 179-1eU)	15 kJ/m^2

thermal properties	
maximum temperature for continuous use	80 °C
maximum temperature for short-term use	85 °C
coefficient of linear thermal expansion (0-50 °C, long) (DIN 53752-A)	7x10-5 1/K
thermal conductivity (DIN 52612)	0.19 W/(K*m)
Heat Deflection Temperature (HDT-B) a 0.46 MPa (DIN ISO 75)	113 °C
Heat Deflection Temperature (HDT-A) a 1.80 MPa (DIN ISO 75)	105 °C

POM

POM	
chemical designation	polyoxymethylene (copolymer)
colour	opaque white

physical and mechanical properties	
density	1.41 g/cm^3
yield strength (DIN EN ISO 527-2)	67 MPa
elongation at break (DIN EN ISO 527-2)	32%
modulus of elasticity in tension (DIN EN ISO 527-2)	2800 MPa
hardness ball falling (ISO 2039-1)	165 MPa
impact strength (Charpy) (DIN EN ISO 179-1eU)	Not broken

thermal properties	
melting point (DIN 53765)	166 °C
maximum temperature for continuous use	100 °C
maximum temperature for short-term use	140 °C
specific thermal capacity	1,4 J/(g*K)
thermal expansion (CLTE) 23°C-60°C (DIN EN ISO 11359-1;2)	13x10-5 1/K
thermal expansion (CLTE) 23°C-100°C (DIN EN ISO 11359-1;2)	14x10-5 1/K

chemical properties	
water absorption at 23° in 24/96 h (DIN EN ISO 62)	0.05/0.1%

Gold alloy

Gold alloy	Castable posts with preformed base in gold alloy	Gold lloy Cap CAP-1	Overcasting for round bar CAV-375
colour	white	yellow	yellow

composition	% of reference		
Au	60 %	> 68.60 %	70 %
Pt	24 %	2.45 %	8.5 %
Pd	15 %	3.95 %	-
Ir	1 %	0.05 %	0.10 %
Ag	-	11.85 %	13.40 %
Cu	-	10.60 %	7.50 %
Zn	-	2.50 %	0.50 %
Au+Pt group metals	-	75.35 %	-
Ru	-	-	-

physical and mechanical properties			
density	18.1 g/cm^3	15.0 g/cm^3	15.7 g/m^2
melting range	1400 ÷ 1460 °C	880 ÷ 940 °C	895 ÷ 1010 °C
modulus of elasticity in tension	115 GPa	97 GPa	100 GPa
Vickers hardness HV5 (gold alloy 2)	160 (annealed) 250 (tempered) 220 (after deformation) 240 (after casting)	> 240	170 (annealed) 295 (after deformation)
limit of elasticity	400 MPa (annealed) 700 (after deformation) 800 (after casting)	> 710 MPa	380 MPa (annealed) 730 (after deformation)
elongation	20 % (annealed) 15 % (after deformation) 1 % (after firing)	> 4 %	37 % (annealed) 13 % (after deformation)

Cobalt chrome alloy*

chemical composition	maximum allowed values (%)
C	0.14
Mn	1.00
Cr	26.00 ÷ 30.00
Ni	1.00
Mo	5.00 ÷ 7.00
N	0.25
Fe	0.75
Co	remainder

physical and mechanical properties	maximum allowed values (%)
density	8.27 g/cm^3
modulus of elasticity in tension	241 GPa
yield strength (0.2%)	585 MPa
tensile stress	1035 MPa
elongation at yield	25 %
section reduction	23 %
hardness	30 HTc

thermal properties	
melting range	1400 ÷ 1450 °C
coefficient of thermal expansion at 500 °C	14.15
coefficient of thermal expansion at 600 °C	14.47
thermal conductivity at 600 °C	25.76W/mK

** This technical information complies with what is expressly specified in the regulations in force for the use of cobalt chromium in implantology:*
- *ISO 5832-12 current edition*
- *ISO 22674 current edition*

Advice for overcasting with base alloys

By Loris Zamuner, dental clinician

Casting with base alloys, which is less predictable than casting with precious alloys, increases the difficulty of maintaining precision at the level of the prosthetic connection, because apart from the factors involving intimate contact between the alloys and mechanical resistance, problems of corrosion may also emerge, as dental technicians are well aware.

As these alloys are oxidized when heated, additional precautions must be adopted when preparing models and during coating and casting procedures, to avoid not only mechanical but also biological complications (e.g. gingival tattoos, namely the blackish marks caused by the redox reaction of prosthesis metals, which are extremely difficult to treat and remove).

With regard to this we would like to offer some advice, which although it may not completely eliminate these problems, may be useful in the laboratory for the correct use of castable posts with a cobalt chrome base:

- Remove the castable sleeve from the base and seal the interstitial space with wax or castable resin, to prevent the possible formation of cracks.
- Apply a layer of deoxidizing solution (e.g. flux) to the metal surface before repositioning and fixing the castable sleeve. This may reduce the quantity of oxides produced during heating of the alloy.
- Modelling must very clearly delimit the area of the junction between the castable sleeve and the prefabricated base with a well-defined closure edge, so as to prevent the overcast alloy from penetrating the base of the post.
- The formation of pins for the creation of cylinders must be carried out in an area with an adequate surrounding volume, to prevent the injected alloy from cooling before it has completely filled the final form. Do not position casting pins in thin areas, to avoid deformations caused by the heat of the molten alloy.
- The expansion of the refractory casting coating must be limited to a minimum, to prevent the formation of spaces between the metal base and the coating caused by the different expansion of the two layers. If the coating and the metal base are not in intimate contact, a thin film of metal could form on the prefabricated base, which if it reaches the connection platform between the implant and the prosthesis could affect precision, giving rise to evident biomechanical and biological problems.
- All parts of the cylinder must be heated uniformly. Since internally it incorporates the prefabricated metal components, which by their very nature absorb heat, it is advisable to maintain the final heating temperature for an extended time, then raising it by about 20–30 °C higher than the temperature recommended by the manufacturer of the alloy.
- When choosing the alloy for overcasting, its fusion temperature must be attentively considered with respect to the fusion temperature of the component to be overcasted, which must be around 80–100 °C higher, to avoid deformations but at the same time to ensure correct bonding between the two alloys.
- After casting, leave the cylinder to cool slowly, to prevent the formation of stresses between the two alloys.
- Avoid contact between the ceramic and the base alloy while firing the ceramic, because the different thermal expansion coefficients may cause cracking in the coating layer.
- Where possible (in non-aesthetic areas) keep the area of interface between the prefabricated base and the overcast structure out of the gingival sulcus.
- With composite screw retained prostheses, incorporate the interface line between the prefabricated base and the overcast structure inside the aesthetic coating.
- Use the same type of alloy for the entire prosthetic reconstruction, to avoid partial weakenings, breakages and the incorrect distribution of forces on the implants.

Remember that this technique may be subject to the problems of mechanical resistance, corrosion and galvanic reactions typical of precious alloys, which are therefore present to a greater extent in base alloys.

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