STELLITE™ 21 ALLOY

TECHNICAL DATA

TIG WELD DEPOSITION | MMA WELD DEPOSITION | MIG WELD DEPOSITION | PTA & LASER WELD DEPOSITION | HVOF & PLASMA SPRAY DEPOSITION

NOMINAL COMPOSITION (MASS %) AND PHYSICAL PROPERTIES

Co	Cr	Mo	C	Ni	Others	Hardness**	Density	Melting Range
Base	26-29	4.5-6.0	0.20-0.35	2.0-3.0	Fe, Si, Mn	27-40 HRC** 290-430 HV**	8.33 g/cm^3 0.301 lb/in^3	2360-2615 °F 1295-1435 °C

** Higher values indicate a typical work hardened surface. Stellite™ 21 can work harden up to 550HV (48HRC).

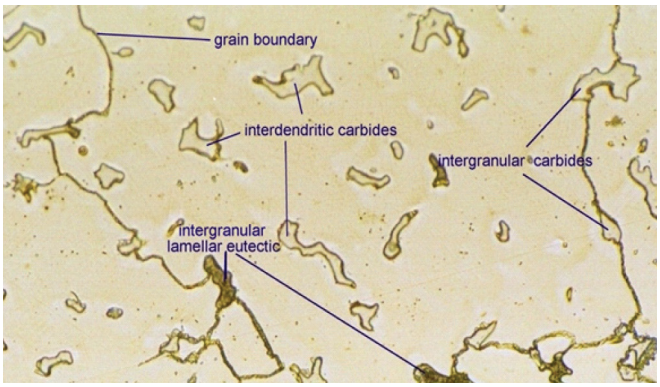
Stellite™ 21 (previously known as **Stellite™ 8**) was developed in the mid 1930s as a corrosion resistant CoCr alloy, and rapidly found application as a biocompatible hip implant and denture alloy. Many of the alloys currently used in medical applications are variants of the original **Stellite™ 21** composition. It was also one of the first heat-resistant alloys trialled for use in jet engines.

Stellite™ 21 consists of a CoCrMo alloy matrix containing dispersed hard carbides which strengthen the alloy and increase its hardness, but also decrease the ductility. The type, shape, size, and distribution of the carbides is strongly influenced by the processing history of the alloy, and for this reason the mechanical properties of **Stellite™ 21** are very dependent upon the manufacturing route and any subsequent heat treatments.

Due to the low volume fraction of carbides, the Co-based alloy matrix dominates the wear and corrosion properties. **Stellite™ 21** has excellent cavitation, galling and metal-to-metal sliding wear resistance, but is not recommended for severe hard particle abrasion. The surface can work harden considerably during wear or even during machining, and the use of correct machining tools and techniques is important to achieve optimal results.

Stellite™ 21 has excellent resistance to thermal and mechanical shock. Optimum high temperature strength is obtained by solution heat treatments at 1200-1240ºC (2190 - 2265ºF) followed by quenching, and aging in the temperature range 700-1150°C (1290-2100°F).

Stellite™ 21 can be cast, powder metallurgically processed, or applied as a weld hardfacing. It is recommended for applications involving cavitation, erosion, corrosion and/or high temperatures, such as valve trim for petrochemical and power generation. Due to its good impact resistance, it has been widely used in the building up of forging or hot stamping dies. The oxyacetylene weld deposition method is not recommended for this alloy.



Optical Micrograph of a Stellite™ 21 investment casting (as-cast, etched, 200X). The carbides in Stellite™21 are usually of the type $(Cr,Mo,Co)_{23}C_6$.

CORROSION RESISTANCE

Stellite™ 21 is resistant to oxidizing and reducing gaseous atmospheres up to 1150°C (2100°F). Because its ternary alloying element is Mo and not W, it has higher resistance to reducing or complex environments (e.g. sulphuric acid, hydrochloric acid, and sour gas) than CoCrW alloys such as Stellite™ 6. The typical electrode potential in sea water at room temperature is approx. -0.3 V (SCE). Like stainless steels, **Stellite™ 21** corrodes primarily by a pitting mechanism and not by general mass loss in seawater and chloride solutions. More information regarding corrosion resistance can be provided on request.

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NOMINAL THERMAL EXPANSION COEFFICIENT (FROM 20°C TO STATED TEMPERATURE)

	100°C (212°F)	200°C (392°F)	300°C (572°F)	400°C (752°F)	500°C (932°F)	600°C (1112°F)	700°C (1292°F)	800°C (1472°F)	900°C (1652°F)
µm/m.K	11.0	11.2	12.0	12.65	13.1	13.6	14.3	14.7	15.21
µ-inch/inch.°F	6.1	6.2	6.7	7.0	7.3	7.6	7.9	8.2	8.45

NOMINAL TENSILE PROPERTIES AT ROOM TEMPERATURE

Note: The Mechanical properties of Stellite™ 21 are very dependent upon the manufacturing route and heat treatment.

	Ultimate Tensile Strength Rm		Yield Stress Rp(0.2%)		Elongation	Elastic Modulus	
	ksi	MPa	ksi	MPa	A(%)	psi	GPa
Castings	103	710	82	565	9	$36.2x10^6$	250
Stellite HS-1 (*)	145	1000	87	650	20	$35.5x10^6$	245

(*) "HS" = HIP-consolidated from the powder form

NOMINAL HOT HARDNESS (DHP) OF UNDILUTED WELD DEPOSIT

20°C (68°F)	100°C (212°F)	200°C (392°F)	300°C (572°F)	400°C (752°F)	500°C (932°F)	600°C (1112°F)	700°C (1292°F)	800°C (1472°F)	900°C (1652°F)
347	279	248	228	208	197	181	153	123	92

THERMAL AND ELECTRICAL PROPERTIES

	Approximate value at Room Temperature	
Thermal conductivity	14.5 W/m.K	100.5 Btu-in/hr/ft²/°F
Electrical resistivity	87.38 µ-ohm.cm	34.4 µ-ohm.cm

PRODUCT FORMS AND CROSS REFERENCE SPECIFICATIONS

Stellite™ 21 is available as welding wire, rod, powder, and electrodes; and as finished castings and powder-metallurgically produced (P/M) parts. Kennametal Stellite also offers hardfacing services.

Stellite™ 21 can be supplied to the following specifications:

SPECIFICATION	PRODUCT FORM
UNS R30021	Rod, Castings
UNS W73041	Wire
UNS W73021	Electrode
AMS 5385	Castings
AMS 5819	Rod, Wire

SPECIFICATION	PRODUCT FORM
AWS A5.21 / ASME BPVC IIC SFA 5.21 ERCoCr-E	Rod
AWS A5.21 / ASME BPVC IIC SFA 5.21 ERCCoCr-E	Wire
AWS A5.13 / ASME BPVC IIC SFA 5.13 ECoCr-E	Electrode
SAE J467	HIP-Consolidated

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