STELLITE 21

STELLITE™ 21 ALLOY

TECHNICAL DATA

TIG WELD DEPOSITION | MMA WELD DEPOSITION | MIG WELD DEPOSITION | PTA & LASER WELD DEPOSITION | CASTINGS & POWDER METALLURGY | ADDITIVE MANUFACTURING

NOMINAL COMPOSITION (MASS %) AND PHYSICAL PROPERTIES

Co	Cr	Mo	C	Ni	Others	Hardness**	Density	Melting Range
Base	26-29	4.5-6.0	<0.35	<3.0	Fe, Si, Mn	27-40 HRC** 290-430 HV**	8.33 g/cm³ 0.301 lb/in³	1295-1435°C 2360-2615°F

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

STELLITE COBALT-BASED ALLOYS consist of complex carbides in an alloy matrix. They are resistant to wear, galling, and corrosion and retain these properties at high temperatures. Their exceptional wear resistance is due mainly to the unique inherent characteristics of the hard carbide phase dispersed in a CoCr alloy matrix.

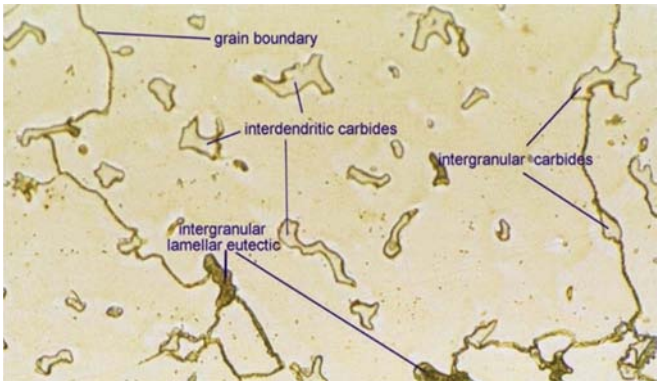
Stellite 21 (previously known as **Stellite 8**) was developed in the mid 1930s as a corrosion-resistant CoCr alloy, and rapidly found application as a biocompatible hip implant and denture alloy. Many of the alloys currently used in medical applications are variants of the original **Stellite 21** composition. It was also one of the first heat-resistant alloys trialed 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 1200–1240C (2190–2265F) followed by quenching, and aging in the temperature range 700–1150C (1290–2100F).

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 approximately -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/68°F 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 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

NOMINAL HOT HARDNESS (DPH) 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.inch

PRODUCT FORMS AND CROSS-REFERENCE SPECIFICATIONS

Stellite 21 is available as welding wire, rod, powder, electrodes, finished castings, and powder-metallurgically produced (P/M) parts.

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

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