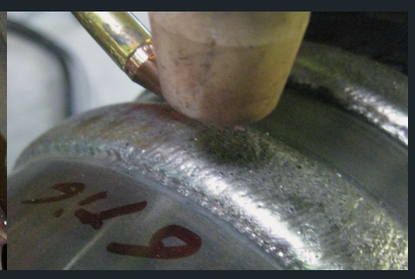
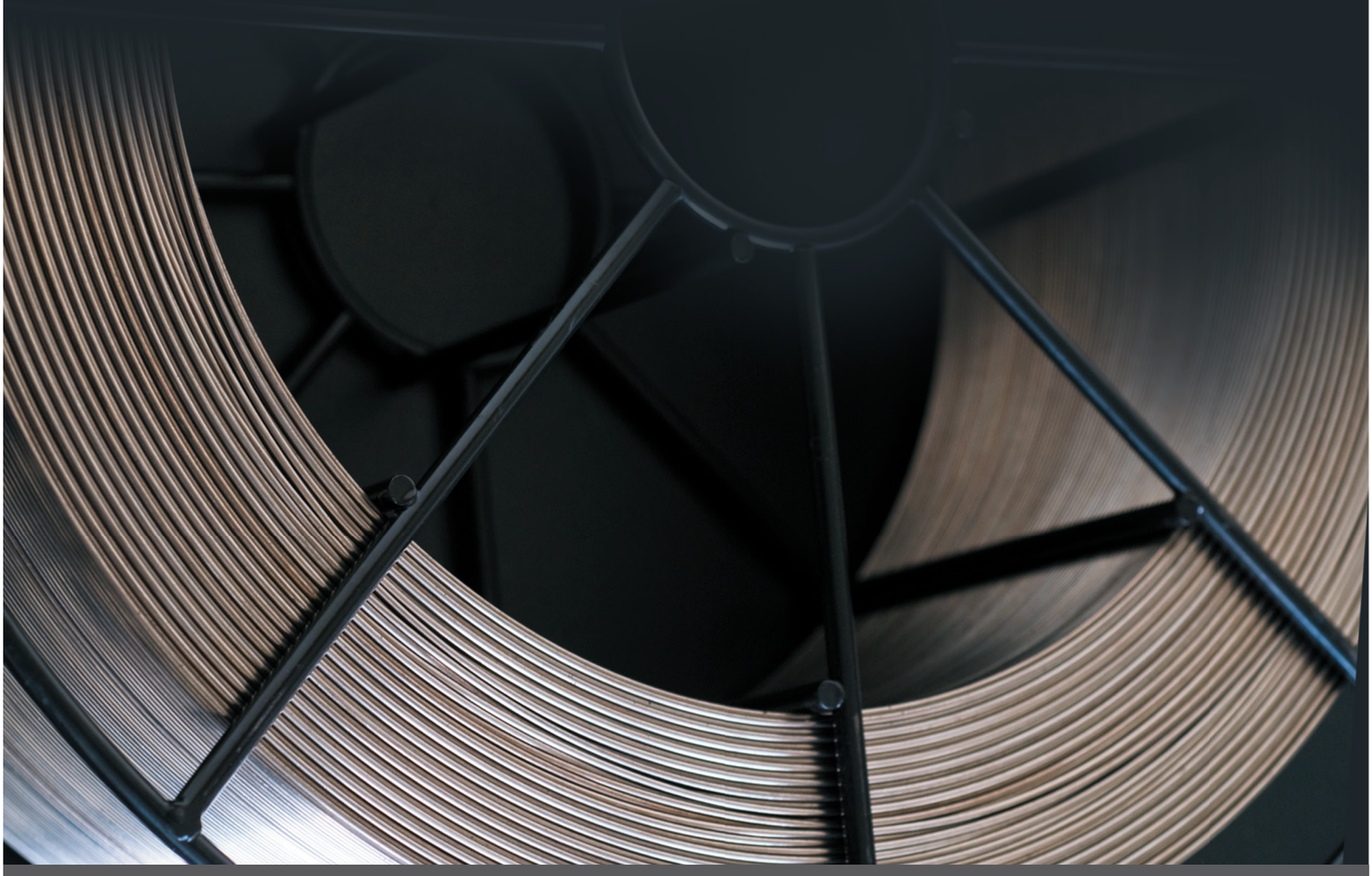
Welding Alloys Group

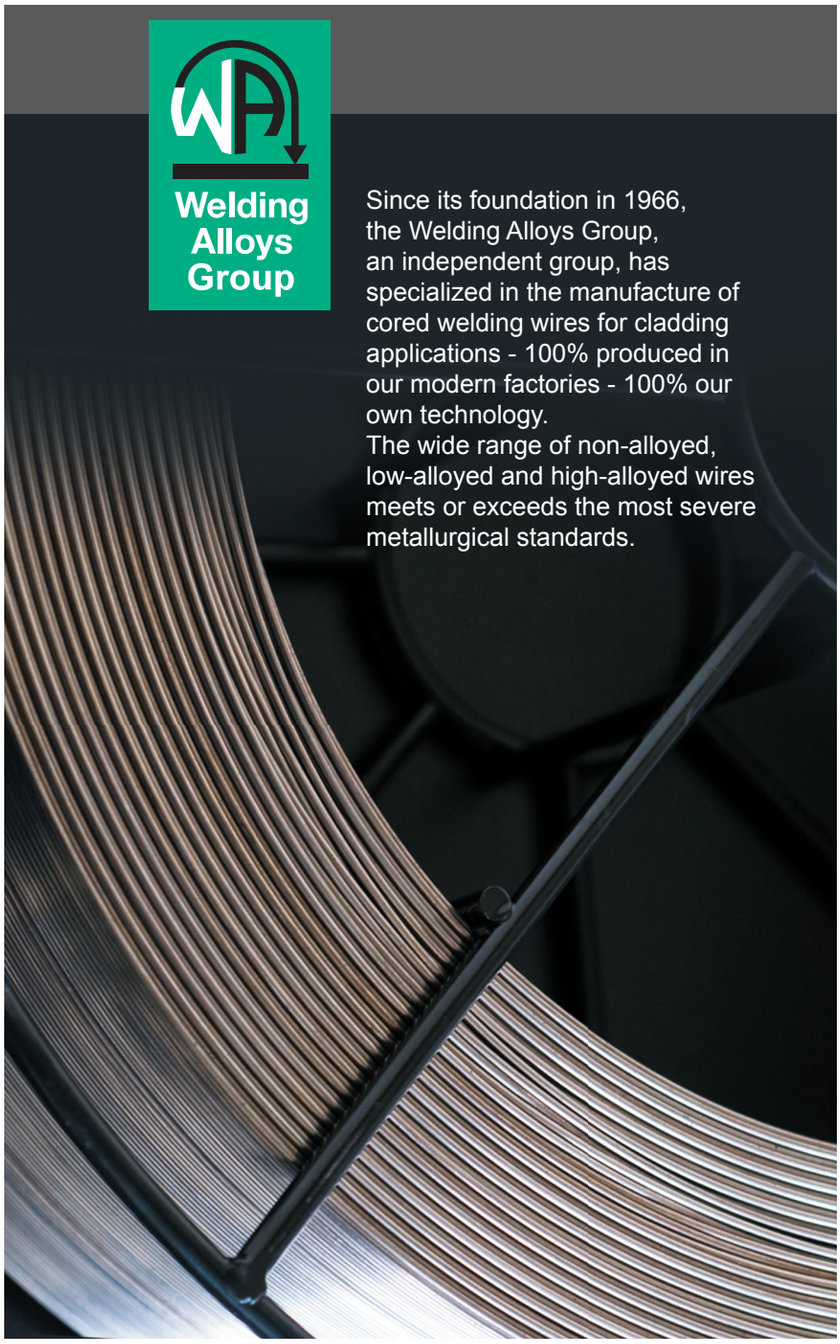




STELLOY Cobalt Products

Cobalt Base Welding Consumables for Cladding and Hardfacing

ACTING GLOBAL
WELDING LOCAL



Welding Alloys Group

Since its foundation in 1966, the Welding Alloys Group, an independent group, has specialized in the manufacture of cored welding wires for cladding applications - 100% produced in our modern factories - 100% our own technology.
The wide range of non-alloyed, low-alloyed and high-alloyed wires meets or exceeds the most severe metallurgical standards.

Summary

STELLOY grades

TYPE	1
	Ø mm
Stelloy -G MIG	1.2, 1.6, 2,4
Stelloy arc welding Electrodes	2.5 - 5,0
Stelloy TIG Wire	N/A
EN 14700	TCo3
Typical Composition of WELD METAL Wt %	C 2.3 Cr 29 W 12 Mn 1.0 Si 1.0 Fe 4,0 Co Bal
Weld Metal Hardness	
20°C Rc	53
Brinell	495-560
200°C	465
400°C	420
600°C	370
800°C	330
Crack Resistance	*
Impact	*
Metal to Metal Wear	***
Corrosion	****
Cold Abrasion	****
Hot Abrasion	****
Machineability	*

Descriptions and Applications	Excellent hot and cold abrasion properties with low coefficient of friction, erosion and oxidation resistance to over 1000°C. Do not use in applications involving impact and where crack free welds are essential. Used on valve steam hardfacing, wire guides, rubber and plastic mixers, extrusion screws and conveyors.	Su sa St for co ma cra sta Us se au on co the pr cra va an of bo on cra es

Ceramic moulds for tyles production
Hardfaced with STELLOY 6-G

HP
Har

	6BC	6	6HC	12	21	25
	Ø mm	Ø mm	Ø mm	Ø mm	Ø mm	Ø mm
	1.2, 1.6, 2,4	1.2, 1.6, 2,4	1.2, 1.6, 2,4	1.2, 1.6, 2,4	1.2, 1.6, 2,4	1.2, 1.6
	N/A	2.5 - 5,0	N/A	2.5 - 5,0	2.5 - 4,0	2,5 - 4,0
	1,2 - 1,6	1,2 - 1,6	1,2 - 1,6	N/A	1,2 - 1,6	N/A
	TCo2	TCo2	TCo2	TCo2	TCo1	T ZCo1
	C 0.9 Cr 28,5 W 4.5 Mn 1.0 Si 1.0 Fe 4,0 Co Bal	C 1.05 Cr 28,5 W 4.5 Mn 1.0 Si 1.0 Fe 4,0 Co Bal	C 1.2 Cr 28,5 W 4.5 Mn 1.0 Si 1.0 Fe 4,0 Co Bal	C 1.5 Cr 30 W 7,5 Mn 1.0 Si 1.0 Fe 4,0 Co Bal	C 0.25 Cr 28 Mo 5.5 Ni 3,0 Mn 1.0 Si 1.0 Co Bal	C 0.15 Cr 20 W 14 Ni 9,5 Mn 1.5 Si 1,0 Fe 4,0 Co Bal
	 38 350-380	Work Hardens 42 380-415 370 320 255 240	 44 410-430	 45 415-455 410 370 315 275	Work Hardens 33 300-340 280 255 235 220	 21 210-260 180 145 130 120
	****	***	**	**	****	****
	***	***	**	**	****	****
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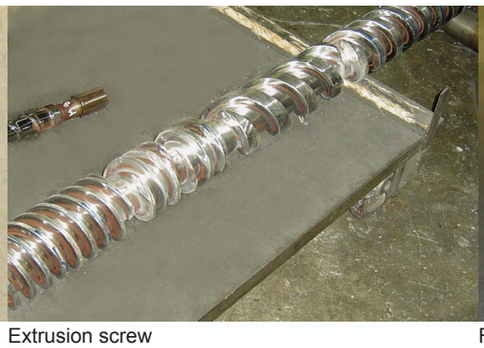
	**	***	***	****	**	***
	***	**	**	**	****	****

ıld of ns d	Substantially the same alloy as Stelloy 6 except for lower carbon content. Easier to machine and less crack sensitive than standard Stelloy 6. Used primarily in semi-automatic and automatic operations on surfacing of large components where the use of No. 6 is problematic due to cracking. Used on valve seats, wedges, and for direct welding of seats into valve bodies. Also used on cylinders where crack free welding is essential.	Combines all the outstanding properties of cobalt base alloys, i.e. excellent erosion and corrosion resistance. Very good metal to metal wear resistance ; maintains hardness to elevated temperatures and can be machined. Used extensively on valve seats of diesel engines, cams, chainsaw bars, hot shear blades, cold forming rolls and hot forming rolls, for hot rolling reinforcing bar, pump parts and components in hot zinc baths.	Substantially the same alloy as Stelloy 6 except for higher carbon content. Designed primarily for applications by MIG where hardness of 40-42 is specified and single run weld is to be used, with 10% dilution. Used on smaller valves and bodies, chain saw bars, extrusion dies etc.	Moderate impact resistance combined with very good metal to metal wear properties. Very good hot and cold abrasion. Retains hardness to high temperatures and less likely to crack than Stelloy 1. Used on saw teeth, cams, shafts, tappets and push rods for engines, screw conveyors and augers for rubber and plastics, seats and valves for oil and gas.	Soft as welded but with work hardening hardness increases to above 45 Rc. Less crack sensitive than other alloys, it is used for build up and on large sections. Moderate cold abrasion but excellent metal to metal wear combined with good corrosion resistance. Used for integral seats and guides of large water and high pressure valve bodies, drop forging dies, pump shafts and sleeves, hot punches etc.	Average hardness. It maintains its hardness at high °C. Not sensitive to cracking. Excellent metal-to-metal wear resistance at high temperatures make this alloy suitable for hot shear blades, hot forming rolls and hot zinc parts.

HP Valves - Ring
Hardfaced with STELLOY 6-G



Extrusion screw
Hardfaced with STELLOY 12-G

Forging die Hardfaced
with STELLOY 21-G

Welding recommendations

Preheating

Preheating can be beneficial in problems arising from hardsurfacing, i.e. reduction of cracks, no hard zones adjacent to welds and minimisation of shrinkage and distortion. The table below is a general guide only and can be varied with engineering experience and with consideration of component size and geometry.

Welding conditions

MIG/MAG

Always pull the bead - instead of pushing (see diagram)

Welding parameters - electrode (+)

GASES : Argon + 1-3% O_2 (10-15 l/min)

Argon (10-20 l/min)

Diameter	Amps	Volts
1.2 mm	100-250	16-29
1.6 mm	140-350	16-30

ARC ELECTRODES

Diameter	DC (+)
2.5 mm	75-110
3.2 mm	95-130
4.0 mm	115-155
5.0 mm	155-185

Consult our technical staff for welding conditions of TIG/PLASMA and OXY-ACETYLENE

Cracks and Porosity

If cracks or porosity occur, solve as follows :
* = Cracks ** = Porosity

*, ** (1) Make sure base is clean of oil, rust, grease etc. and check base metal for cracks before welding.

*, ** (2) Excess moisture, either in flux, rods etc. Rebake as follows : Coated rods = 1 hour at 250°C
Flux Cored Wire = 2 hours at 150°C

* (3) Hardsurface is too thick - reduce depth or change material

* (4) Increase pre-heat

* (5) Post-heat to 700-800°C in extreme cases and allow slow cooling

* (6) Use softer grade, e.g. 6BC instead of 6

*, ** (7) Reduce arc length during welding (voltage)

Hardness Variations and Controlling Dilution

Cooling rate will have little or no effect on hardness of cobalt base alloys. The principal cause for hardness variation in deposits is variation in dilution levels, particularly in the first two layers. Variations in the welding parameters can markedly change dilution levels.

Dilution is measured by the percentage of base material in the weld metal.

Dilution is lessened by decreasing : • Arc Voltage • Arc Current • Preheat and Interpass Temperature

And increased by : • Travel Speed • Pulsed Welding

Recommended preheats (°C) for

PRODUCT STELLOY / BASE METAL GRADE	< 0.3% Carbon Steel	0.3-0.5% Carbon Steel
1	350	350
6BC	150	200
6	200	250
6HC	200	250
12	275	300
21	100	150
25	100	150

Cladding STELLOY 6-G on S 235

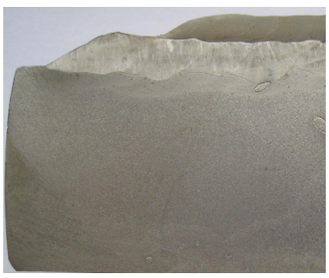
Type 309L

Type grade 6

Type grade 21

Measurements hardness layer 1 and 2

Base material S 235	Job 1	
	Layer 1	
Type	TETRA S 309L-G	
Diameter (mm)	1,2	
Voltage (V)	29	
Amperage (A)	250	
Wire Feed (m/min)	9,6	
Shielding Gas	Argon +18 % CO_2	
Welding Speed (m/min)	0,40m/min	
Pre-heating and inter-pass temp.		
Current type	DC+	
Results Hardness	**27 HRC**	



Cladding :
First layer 309L
Second layer STELLOY 6-G

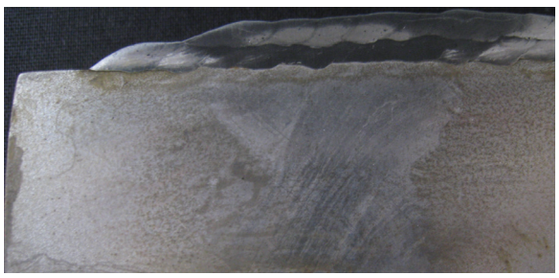
) for 1-layer clad of STELLOY on different base metals

-0.5% n Steel	Up to 3% Total Alloy Steels	3-10% Total Alloy Steels	Martensitic High Alloy Steels e.g. 12% Cr	Ferritic High Alloy Steels e.g. 17% Cr	Austenitic High Alloy Steels e.g. 316	Nickel Alloys e.g. Stelloy C
50	350	350	350	350	250	250
00	200	250	300	100	100	100
50	250	250	300	150	150	150
50	250	300	300	200	150	150
00	300	300	300	250	200	200
50	150	200	200	100	100	100
50	150	200	200	100	100	100

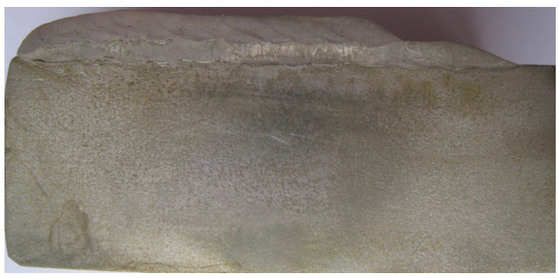
235 Carbon steel – 20 mm thick - with different inter-layers:

Job 1		Job 2		Job 3	
	Layer 2	Layer 1	Layer 2	Layer 1	Layer 2
	STELLOY 6-G	STELLOY 6-G	STELLOY 6-G	STELLOY 21-G	STELLOY 6-G
	1,2	1,2	1,2	1,2	1,2
	21	21	23	20	21
	180	180	180	170	180
	5,1	5,1	5,1	6	5,1
	Argon 4.6	Argon 4.6	Argon 4.6	Argon 4.6	Argon 4.6
	0,38m/min	0,40m/min	0,38m/min	0,40m/min	0,38m/min
	> 150°C	> 300°C	> 300°C	> 300°C	> 300°C
	Pulsed	Pulsed	Pulsed	Pulsed	Pulsed
	35 HRC	**39 HRC**	**42 HRC**	**31 HRC**	**44 HRC**

G

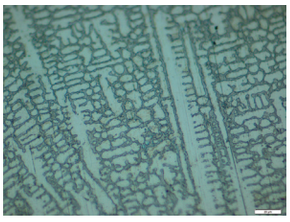


Cladding :
First layer STELLOY 21-G
Second layer STELLOY 6-G

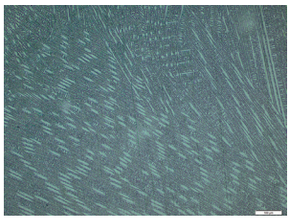


Cladding :
First layer STELLOY 6-G
Second layer STELLOY 6-G

Most cobalt base alloys for hardfacing consist of alloying cobalt with chromium, tungsten, molybdenum, carbon, and occasionally with iron. Chromium aids in corrosion resistance, usually in the range of 25-35%. Tungsten usually in the range from 3-12% and molybdenum improve the strength at elevated temperatures. Alloys viewed under the microscope typically consist of chromium and tungsten carbides in a Co-rich tough matrix.



Microstructure - STELLOY 1

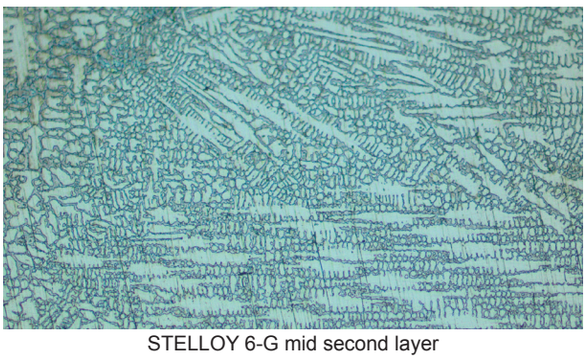


Microstructure - STELLOY 6

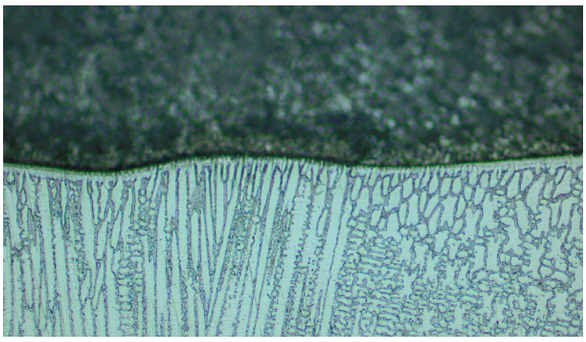
Excellent wear resistance as well as work hardening capacity of the Cobalt-rich matrix is due to low stacking fault energy and a high degree of stacking faults.

When Stelloy wires are welded using recommended welding conditions, a very low level of dilution is achieved and undiluted weld metal composition can be attained after 5 mm cladding (fig. 1).

Carbon is the principal addition to increase hardness of these alloys, with tungsten and chrome having a secondary effect. The higher the carbon the better the abrasion resistance, however, resistance to mechanical impact can be adversely affected.



STELLOY 6-G mid second layer



STELLOY 6-G bottom second layer

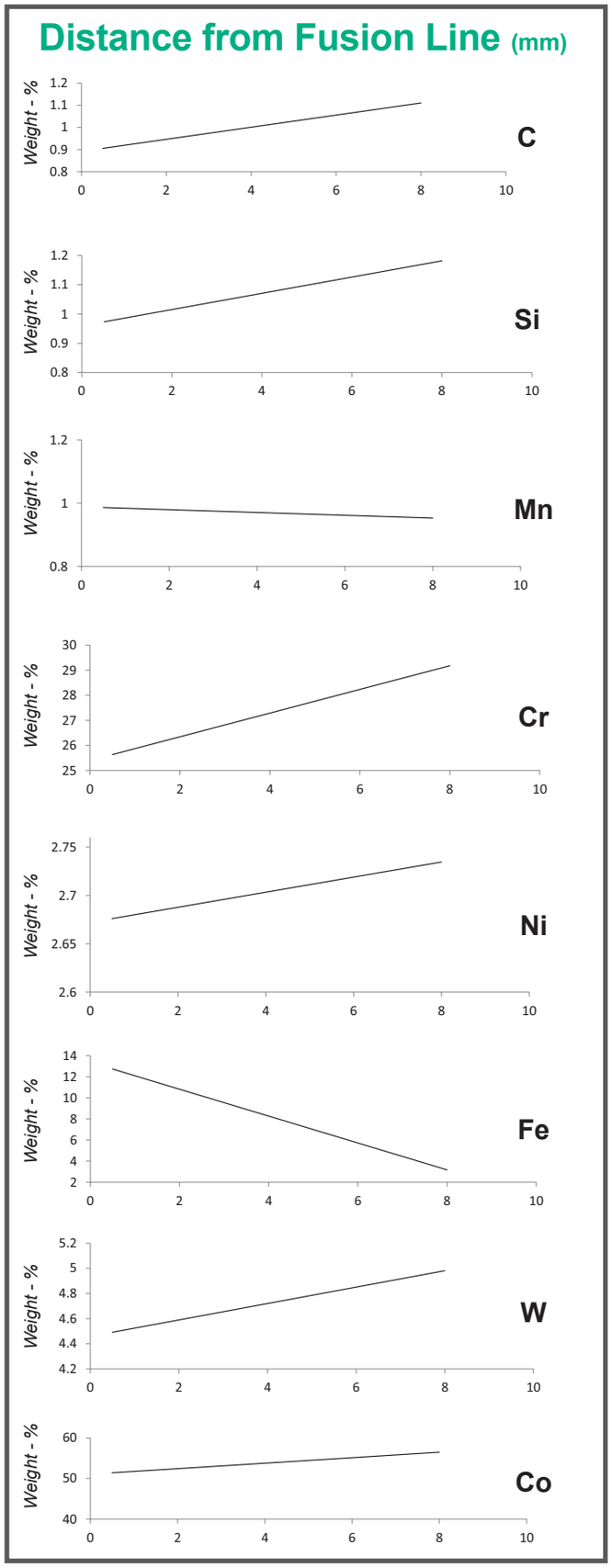
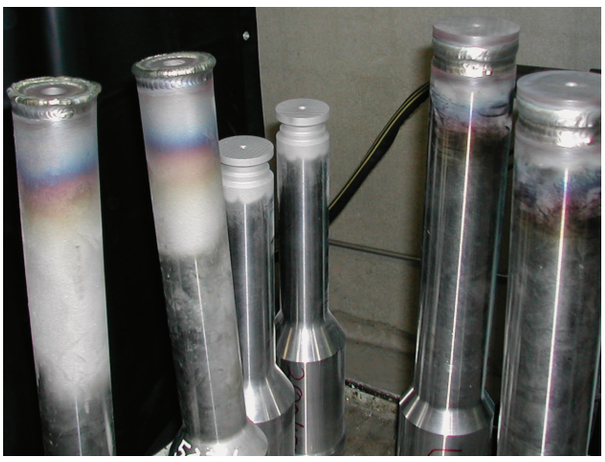
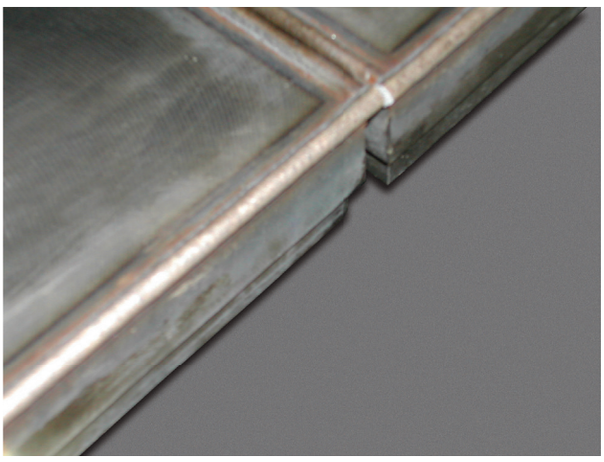


Fig. 1 - Cladding on C-steel - Chemical analysis evolution STELLOY 6-G

Different applications STELLOY 6-G



Forging plunger for bearings manufacturing
Hardfaced with STELLOY 6-G



Ceramic Mould detail
Hardfaced with STELLOY 6-G

Packaging (other packaging available upon request)

	Spool (to order)	Spool (stock)	Pay off pack (to order)
Diameter mm	1.0 , 1.2	1.0 , 1.2 , 1.6	1.2, 1.6 only
Weight	5 kg	15 kg	250 kg

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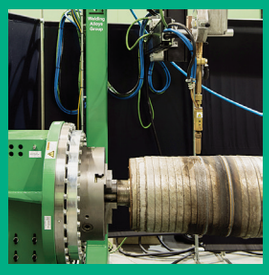

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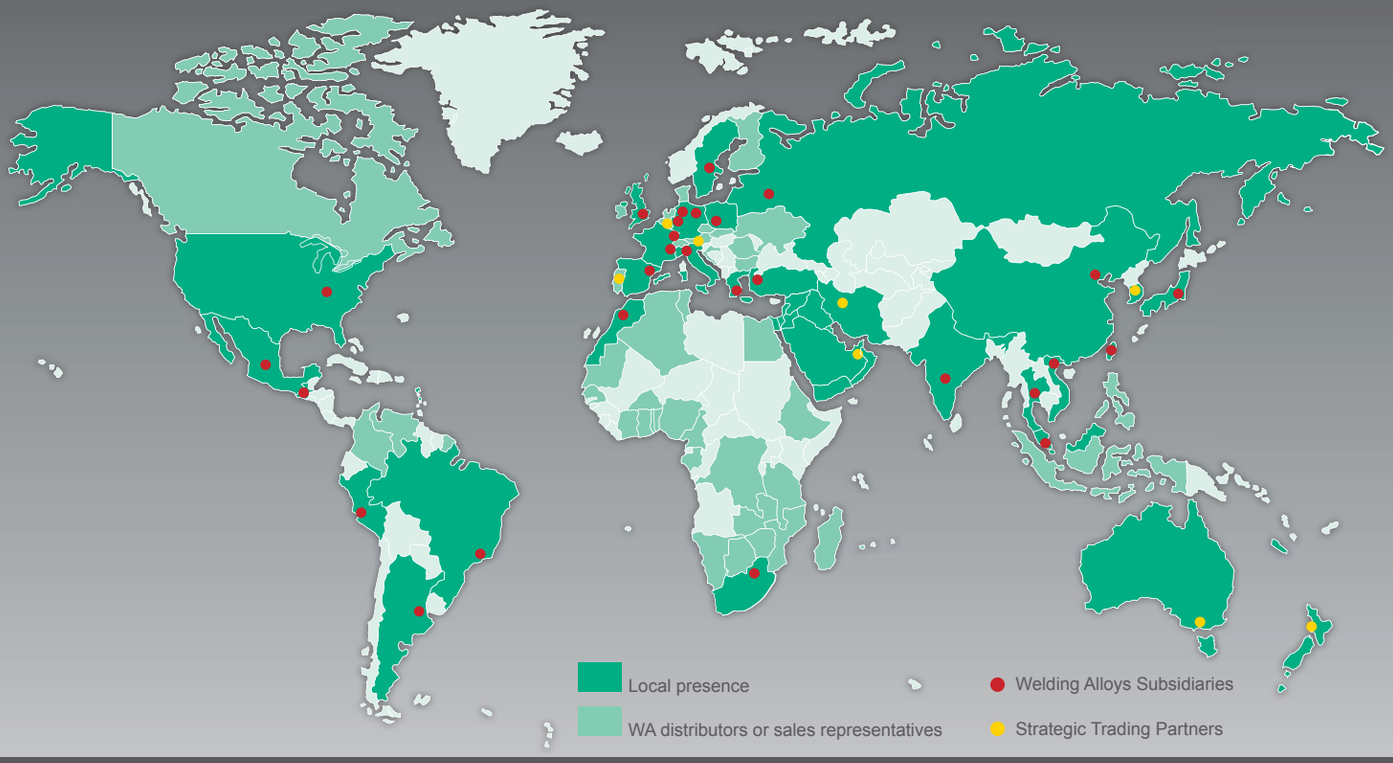

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