

SUPER ALLOYS




**SUN FLAG
STEEL**

SUPER ALLOYS

India is fast developing economy with population over 120 million with vast border. To meet the growing demand of our population and protect our border, growth of technology is inevitable. The growth of technology is relevant to sectors like Biomedical, Aerospace, Petrochemical, Thermal and Nuclear Plants, Defense, Armament, Transport etc. To attain high level of perfection in this sectors depends, on availability of stringent quality of rawmaterial. As on date most of raw material is imported.

Government of India has embarked upon ambitious program of self reliance through make in India program. Sunflag widely accepted as marquee company in supplying high quality material to automobile and general Engg Industries wish to enter this high tech area. The fast developing electrical vehicle technology may also require these advanced high tech material in high volume.

These hi tech material are used in making Aircraft Parts, Bio Medical Implants, Industrial and Vehicle Gas Turbines, Super Critical Power Plants Parts, Space Vehicles and Rocket Engines, Submarine Parts, Nuclear Reactor, Missiles and Arnaments etc.

The high performance high tech alloys required by these industries are required to be operated at a load and temperature above 500 degree centigrade with resistance to oxidation and environmental attack, that are usually prevalent at this temp. Hence the raw material used for this high sectors requires low level of impurities and meeting with stringent spec.

In nature, we rarely come across very pure material and it contains metallic impurities like lead, bismuth, etc , non metallic impurities like sulphur. phosphorous etc, residual gases like oxygen, hydrogen and nitrogen and nonmetallic impurities like oxides, nitrides. Sulphide etc.

The above impurities considerably reduced in conventional technology of arc furnace, AOD, LRF and VOD and the low level of impurities required by these hi-tech industries can be achieved only by melting at Vacuum Induction Melting [VIM], Electro Slag Refining [ESR] and Vaccum Arc Re-melting furnace [VAR] etc apart from other specialised melting.

Sunflag has put up VIM, ESR, VAR facility at Bhandara Plant near Nagpur. These equipment have latest technology and supplied by the World Leaders in this field, Sunflag also have tie up with DAIDO Japan, who are well known have equity participation with Sunflag. DAIDO also provide inputs for improvement in the technology.

Sunflag other facilities include Concast, Blooming Mill, specialised Rolling Mill, Heat Treatment facilities and Bright Bar and Centerless Grinding Facility.

To test these high tech material, most modern lab equiped with good analytical instruments, metallographic equipments, mechanical testing equipment for testing RT, LT and HT specimens. Online Phase Arrey Machines for testing UT, eddy current, MPI and FPT tests also available to test the product to various national and international standards.

Sunflag has trained manpower who have specialised skill to operate these most modern equipments & control.



SUNFLAG HI TECH GRADES

S.No.			Fe	Ni	Cr	Mo	Co	Cu	Ti	C	Mn	Al	Others
SPECIAL STEEL													
1	SUN V250	Maraging 250		18		4.8	8.5		0.4			4.2	
2	SUN V174	17-4PH	0.07	4	16.5			4					
3	SUN V155	15-5PH	0.07	5	15			4	0.8				
4	SUN V11-10	11-10PH	0.03	10	11	2							
5	SUN V904L	AVESTA 904L	0.02	25	19.5	4.5							
6	SUN V138	13-8Mo		8	12.5	2.3				0.05		1.1	
HEATING ELEMENT ALLOYS													
1	SUN HEAT80	NICROME 5		80	20								
2	SUN HEAT60	NICROME 3		60	40								
SOFT MAGNETIC IRON													
1	SUN MAG36B	PERM ALLOY D	Bal.	36	36								
2	SUN MAG48B	PERM ALLOY B	Bal.	48	48								
	SUN MAG78	MUMETAL	Bal.	78	78								
CONTROLLED EXPANSION ALLOYS													
1	SUN CE36	INVAR	Bal.	36	36								
2	SUN CE42	N42	Bal.	42	42								

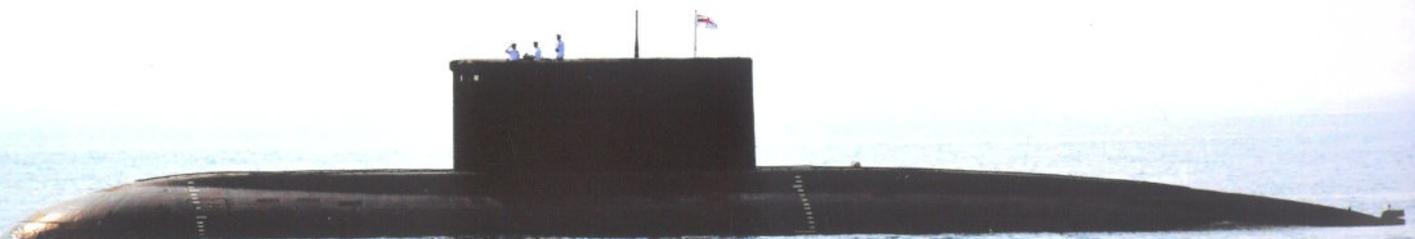
SUNFLAG HI TECH GRADES

S.No.	SUPER ALLOYS	EQU. GRADE	Fe	Ni	Cr	Mo	Co	Cu	Ti	C	Mn	Al	Others
IRON BASED													
1	SUN R MDS	INCOLLOY DS	Bal.	38	18		18	0.5	0.2	0.1			Si 2.1
2	SUN R 800/800H	INCOLLOY 800/800H	46	32	21				0.38	0.1			
3	SUN RA286	A 286	53	26	15	1.24			2.15			1.4	V 0.3
NICKLE BASED													
1	SUN P600	INCONEL 600	8		15.5								
2	SUN P76	NIMONIC 76	4	75	19.5			0.4					
3	SUN P80A	NIMONIC 80A		75	21			2.45					
4	SUN P90	NIMONIC 90		59	19.5		19	2.5					
5	SUN P690M	INCONEL 690M	7-11	58 Min	27-31			0.5	0.6	0.5	0.5		B 0.006, S 0.015
6	SUN P740	INCONEL 740	0.7	bal	25	0.5	20		1.8	0.03	0.3	0.9	Nb2
7	SUN P825	INCOLLOY825	30	42	21.5	3		2.25	0.9	0.03	0.5	0.1	
8	SUN P750	INCONEL 750X	7	73	15.5			0.25	2.5	0.04	0.5	0.7	Nb 0.95
9	SUN P625	INCONEL 625	2.5	61	21.5	9			0.2				Nb 3.15-4.15
10	SUN P718	INCONEL 718	18.5	52.5	19	3.05		0.15	0.9	0.04	0.18	0.5	Cb+Ta 5.13
11	SUN P82	INCONEL 82	3	bal	20				0.55		3		Nb 2.5
12	SUN PC276	HASTE ALLOY C276	5	62	0.6	28				0.02	1		V 0.3
13	SUN P617	INCONEL 617		44.5	23	9	13					1	B 0.006
14	SUN P706M	INCONEL 706	40	41.6	16	0.5	0.5		1.75				
COBALT BASED													
	SUN B605	INCONEL 605		10	20		BAL				1.5		W 15

TYPICAL PROPERTIES OF SOME GRADES

SUPER ALLOYS

GRADE	NOMINAL COMPOSITION (in%)	MECHANICAL PROPERTIES		
		0.2%PS (kg/mm ²)	UTS (kg/mm ²)	%EI
SUN R MDS	Ni 37, Cr 18, Cu 0.5, Ti 0.2, Si 2.1, C 0.1, Fe Bal	36.0	68.0	37
SUN R 800/800H	Ni 32, Cr 21, Al 0.3, Mn 1.5max, Ti 0.3, Si 1max, C 0.1max, Fe Bal	32.6	70.0	40
SUN P 600	Fe 10max, Ni Bal, Cr 15.5, Mn 0.5	24.6	56.0	30
SUN P 76	Fe 18.5, Ni Bal, Cr 21.0, Co 2.5max, Cu 0.2, Mo 9.0, Mn 1.0, C 0.1 Others W-0.5	27.5	80.0	30
SUN P 80A	Fe 1max, Ni Bal, Cr 19, Co 2.0max, Al 1.5 Ti 2.5, C 0.07	70.5	105.0	20
SUN P 90	Fe 1max, Ni Bal, Cr 19, Co 19, Al 1.5 Ti 2.5, C 0.08	68.0	108.0	20
SUN P 718	Fe 18.5, Ni Bal, Cr 19.0, Cu 0.15, Al 0.50, Mo 3.05, Mn 0.18, Ti 0.90, Si 0.18, C 0.04, Others Cb+Ta-5.13	83.0	103.0	12
SUN P 750	Fe 7.0, Ni Bal, Cr 15.5, Cu 0.25, Al 0.70, Mn 0.50, Ti 2.50, Si 0.25, C 0.04, Others Cb+Ta-0.95	63.0	98.0	8
SUN P 825	Fe 30.0, Ni 42.0, Cr 21.5, Cu 0.25, Al 0.10, Mo 3.0, Mn 0.50, Ti 0.90, Si 0.25, C 0.03			
SUN P 82	Fe 3.0, Ni Bal, Cr 20.0, Mn 3.0, Ti 0.55, Others Nb-2.5	95.0	42.0	
SUN P C276	Fe 6.0, Ni Bal, Cr 15.0, Mo 16.0, Mn 1.0, Si 0.08, C 0.02, Others W-35			
SUN P 690M	Ni 58 min, Cr 27-31, Fe 7 to 11, C 0.05, S 0.015, Mn 0.5, Si 0.5, Cu 0.5, Ti 0.6, B 0.006	24.0	58.0	30
SUN P 617	Ni 44.5 min, Cr 20-24, Co 10-15, Mo 8-10, Al 0.8-1.5, B 0.006, C 0.05-0.15, Fe 3.0, Mn 1.0, Si 1.0, S 0.015, Ti 0.6, Cu 0.5	32.0	73.0	62
SUN P 625	Ni 58, Cr 20-23, Fe 5, Mo 8-10, Nb + Ta 3.15-4.15, Co 1.00	27.0	60.0	30
SUN P 740	C 0.03, Cr 25, Mo 0.5, Co 20, Al 0.9, Ti 1.8, Nb 2.0, Mn 0.30, Fe 0.7, Si 0.5, Ni bal	72.0	115.0	50
SUN P 706M	Ni + Co 39.0-44.0, Cr 14.5-17.5, Nb+Ta 2.5-3.3, Ti 1.5-2.0, Al 0.40, C 0.06, Cu 0.30, Mn 0.35, Si 0.35, S 0.015, P 0.020, B 0.006, Co 1.00	99.0	128.0	18





SPECIAL STEELS

GRADE	NOMINAL COMPOSITION (in%)	MECHANICAL PROPERTIES		
		0.2%P.S (kg/mm ²)	UTS (kg/mm ²)	%EI
SUN V 174	C 0.07, Ni 4.0, Cu 4.00, Cr 16.5, Fe Bal, Others Nb-0.3, Condition H1100.	72	93	16.50 ft lb(cvm)
SUN V 250	C 0.01, Ni 18.5, Co 8.5, Fe Bal, Condition 480°C, Others Mo-4.8, Ti-0.4, Ak-4.17 Condition Aged	178	185	100 MPaVm
SUN V 904L	C 0.02, Ni 25.0, Cu 1.5, Cr 19.5, Fe Bal, Others Mo-4.5	22	50	36
SUN V 15-5PH	C 0.07, Mn 1.0, P 0.040, S 0.030, Si 1.0, Cr 14.0-15.0, Ni 3.50-5.50, Cu 2.50-4.50, Cb + ta 0.15-0.45, Ti 0.6-1.0, Al 0.2, Nb 0.15, Cu 0.3 Fe-bal	795	965	14
SUN V 11-10PH	C 0.03, Si 0.15, Mn 0.1, P 0.01, S 0.01, Cr 10.0-11.0, Ni 9.0-10.3, Mo 1.8-2.3	1270	1370	8

CONTROLLED EXPANSION ALLOYS

GRADE	NOMINAL COMPOSITION (in%)	MEAN COEFFICIENT OF THERMAIL EXPANSION (10-7)	
		0-100°C	0-200°C
SUN CE 36	Ni 36, Fe Bal	12	23
SUN CE 42	Ni 42, Fe Bal	47	45

RESISTANCE ALLOYS

GRADE	NOMINAL COMPOSITION (in%)	PHYSICAL PROPERTIES	
		Resistivity at 20°C	Max working temp
SUN HEAT 80	Ni 80, Cr 20, R	109	1200
SUN HEAT 60	Ni 60, Cr 15, Fe Bal	112	1150
SUN HEAT 45	Ni 45, Cr 25, Fe Bal	112	1150
SUN HEAT 30	Ni 30, Cr 20, Fe Bal	104	1100

Clean Steel
State of the Art Process Technology

SOFT MAGNETIC ALLOYS

GRADE	NOMINAL COMPOSITION (in%)	TYPICAL MAGNETIC PROPERTIES				
		Strip Thick	Bs Tesla	μ_{max}	μ_{2max}	Coercive force
SUN MAG 36B	Ni 36, Fe Bal	0.3	1.3	20000	17000	0.15
SUN MAG 48B	Ni 48, Fe Bal	0.3	1.3	55000	35000	0.08
SUN MAG 78B	Ni 78, Cr 0.05, Cu 5, Mo 4, Fe Bal	0.1	0.7	160000	140000	0.012
SUN MAG 78D	Cr -do-	0.1	0.7	390000	250000	0.006
SUN MAG 78E	Cr -do-	0.1	0.7	560000	280000	-0.004

SUPER ALLOYS DIVISION

Infrastructure for Manufacture of Super Alloys

Equipment	Make	Capacity (MT)
Vacuum Induction Melting (VIM)	CONSARC (USA)	6.5 MT
Vacuum Arc Re-melting (VAR)	CONSARC (USA) ALD (Germany)	2.2 MT 16 MT
Electro Slag Re-melting (ESR)	CONSARC (USA) ALD (Germany)	1.8 MT 22 MT

ELECTRO SLAG REMELTING (ESR)

Product Range: 1.8MT to 22MT

Salient Features :

- Automatic Electrode Feed Control System
- Real Time Automatic melt Control System through pre-defined recipe
 - ✓ Full automatic operation
 - ✓ Automatic start phase of the furnace by a defined power/time profile
 - ✓ Realtime Melting rate control through maintaining melting rate or melting power profile with respect to the consumed weight of electrode
 - ✓ Automatic hot topping as per recipe defined power/time profile
- Pre-defined profiles for various stages of processing e.g. slag resistance set point profile or swing set point profiles.
- Digital Operator Interface and data acquisition system
- Furnace head provided with x-y angular corrections of electrode and total sealed system for argon shielded melting
- Fume exhaust and environment protection hood
- Fully coaxial high current feedings system



Vacuum Arc Remelting (VAR)

Product Range: 2 MT to 16 MT

Salient Features :

- Fully computerized automatic melt control system based on dynamic electrode feed control system with arc voltage control/drip short pulse rate control
- Real Time Automatic melt Control System through pre-defined recipe
 - ✓ Full automatic operation
 - ✓ Automatic start phase of the furnace by a defined power/time profile
 - ✓ Realtime Melting rate control through maintaining melting rate or melting power profile with respect to the consumed weight of electrode
 - ✓ Automatic hot topping as per recipe defined power/time profile
 - ✓ Recipe defined profiles for electrode control feed systems for start-melt-hot topping phase.
- Digital Operator Interface and data acquisition system
- Furnace head provided with x-y angular corrections of electrode and total sealed system
- Fume exhaust and environment protection hood
- Fully coaxial high current feedings system
- Ultimate vacuum level of 1×10^{-3} mbar

Vacuum Induction Melting (VIM)

Product Range: 1 MT to 6 MT

Salient Features :

1. Furnace equipped with mould height 4000 MM
2. Facility for Rapid exchange of crucible
3. Multiple mould pouring
4. Facility for bulk and additional charging of mix under vacuum
5. Sampling and temperature measurements under vacuum
6. Fully Rollaway head for facilitating cleaning of melt chamber
7. Ultimate vacuum level of 1×10^{-4} mbar

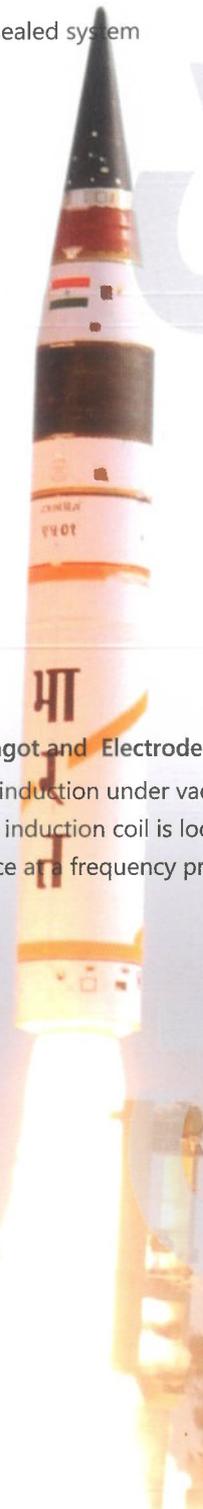
Vacuum Induction Melting Furnace

6.5 Ton x 4000 mm (Tall Vacuum Induction Melting & Casting Furnace for Ingot and Electrode Production)

Vacuum Induction Melting (VIM) is the melting of metal via electromagnetic induction under vacuum.

An induction furnace containing a refractory lined crucible surrounded by an induction coil is located inside a vacuum chamber. The induction furnace is connected to an AC Power source at a frequency precisely correlating to the furnace size and material being melted.

VIM is a process used to make super alloys, stainless steels, magnetic alloys, electronic alloys, and other demanding high value alloys.



Steel
State of the Art Process Technology

Product Range for Super Alloys, Other Hi Tech Grades

Type	Size Range (mm)	Supply Condition
Hot Forged		
Bars	150 to 500 (OD)*	<ul style="list-style-type: none"> • Forged and Machined • Annealed • Hardened & Tempered • Solution Annealed • Aged * High strength alloys
Rings	400 to 2000 (OD)*	
Discs	Upto 800 dia*	
Cylinder	1000 (OD)* - 4500 (Length)	
Hot Rolled		
Bars	15 to 350 dia	
Flats	50 to 150 (W) & 5 to 34 (T)	
Wire Rod Coils	5 to 38 dia	
Round Corner Squares	40 to 350	
Hexagons	15 to 25 A/F	

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AD 2000 Merkblatt WO /PED Certified by TUV Nord

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