630 (17-4) Precipitation Hardening Stainless Steel Bar

630 is a 17-4 PH martensitic precipitation hardening stainless steel with a unique combination of high strength and good corrosive resistance. Supplied in either the H1075 (H580) aged condition with a tensile strength of 1000 Mpa minimum (HB 311 min.), or the H1150 (H620) double aged condition with a tensile strength of 930 Mpa minimum (HB 277 min.).

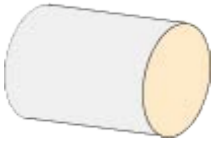
It is characterised by high tensile strength and high yield strength obtained by solution annealing, followed by a single or double low temperature (precipitation) age hardening treatment. Coupled with a corosion resistance comparable to 304 austenitic stainless steel in many corrosive environments.

630 in the H1075 (H580) aged condition can be re-aged if necessary at a higher temperature simply by heating at the required temperature for the required duration.

630 in the H1075 (H580) And H1150 (H620) aged condition, can also be re-aged at a lower temperature by re-solution annealing, followed by age hardening at the required temperature for the required duration.

It is used extensively by the Marine, Aerospace, Chemical, Petrochemical, Food Processing, Paper and general metalwork industries. Here it is employed for applications such as: Pump Shafts, Aircraft Fittings, Valve Stems, Hydraulic Fittings, Studs, Bushings, Screws, Fasteners, Couplings, Wear rings, Rollers and Food Handling Equipment etc..

Material Magnetic in all conditions.

Colour Code  Salmon (Bar end)	Stocked Sizes	15.88 mm to 304.8 mm diameter.
	Bar Finish	Peeled, Cold Drawn, Turned and Centreless Ground.

Related Specifications		
	Australia	AS 2837-1986-630
	Germany	W.Nr 1.4542 X5CrNiCuNb17 4 W.Nr 1.4548 X5CrNiCuNb 17 4 4
	Japan	JIS G4303 SuS 630
	USA	AISI 630 AISI S17400 ASTM A564/A564M-99-630 SAE J467 17-4 PH UNS S17400

Chemical Composition	**Min.**	**Max.**
Carbon		0.07
Silicon		1.00
Manganese		1.00
Nickel	3.00	5.00
Chromium	15.00	17.50
Copper	3.00	5.00
Niobium	0.15	0.45
Phosphorous		0.04
Sulphur		0.03

Mechanical Test Requirements in Solution Annealed and Age Hardened Conditions - At Room Temperature

*Conditon	Ruling Section	UTS MPa (Min)	Yield MPa (Min)	Elongation % in 50 mm (Min)	Hardness		Impact Charpy - V	
					Rc	BHN	ft/lbs (Min)	Joules (Min)
A					38 Max	363 Max		
					Min.	Min.		
H900 (H480)	Up to 200 mm	1310	1170	10	40	388		
H925 (H495)	Up to 200 mm	1170	1070	10	38	375	5	6.8

H1025 (H550)		1070	1000	12	35	331	15	20
H1075 (H580)		1000	860	13	32	311	20	27
H1100 (H595)	Up to 200 mm	965	795	14	31	302	25	34
H1150 (H620)		930	725	16	28	277	30	41
H1150M (H620M)		795	502	18	24	255	55	75
H1150D (H620D)		860	725	16	24	255	30	41
					33 Max	311 Max		

*Refer Age Hardening temperature table

Typical Mechanical Properties - At Room Temperature

*Conditon	UTS MPa	Yield MPa	Elongation % in 50 mm	Hardness		Impact Charpy - V	
				Rc	BHN	ft/lbs	Joules
A	1100	900	15	36	340	30	40
H900 (H480)	1375	1275	14	44	420	15	20
H925 (H495)	1310	1205	14	42	390	25	34
H1025 (H550)	1170	1140	15	38	350	35	47
H1075 (H580)	1140	1035	16	36	340	40	54
H1100 (H595)	1035	930	17	35	330	45	61
H1150 (H620)	1000	860	19	33	310	50	68
H1150M (H620M)	860	600	22	27	275	100	135
H1150 (H620D)	950	800	20	31	295	90	120

*Refer Age Hardening temperature table

Low Temperature Properties

Retains relatively good ductility at sub zero temperatures, with impact properties greatly improved at higher ageing temperatures:-

Typical sub zero charpy V-notch impact properties

Test Temperature		Impact Strength					
		H925	(H495)	H1025	(H550)	H1150	(H620)
°F	°C	ft - lb	J	ft - lb	J	ft - lb	J
10	-12	16	22	58	79	93	126
-40	-40	9	12	40	54	76	103
-112	-80	5	7	15	20	48	65

-148	-100	5	7	12	16	37	50
-320	-196	3	4	4	6	6	8

Cold Working

Cold bending etc. will be limited by the high yield strength in all conditions.

Corrosion Resistance

Superior to the martensitic stainless range in all conditions, and equal to 302 or 304 austenitic stainless grades in most environments.

For optimum corrosion resistance, surfaces must be free of scale and foreign particles. Finished parts should be passivated.

Forging

Heat uniformly to 2150/2200 ^{o}F (1177/1204 ^{o}C) - Hold for 1 hour at temperature prior to commencing forging.

Do not forge below 1850 ^{o}F (1010 ^{o}C).

Finished forgings should be cooled in air to below 90 ^{o}F (32 ^{o}C) prior to further processing in order to obtain optimum grain size and mechanical properties.

Finally forgings will require to be solution annealed prior to age hardening as required.

Heat Treatment

Solution Annealed - Condition A

Heat to 1900 +/- 25 ^{o}F (1040 +/- 15 ^{o}C) - *Hold for 30 Minutes

Sections up to 75 mm - Oil Quench To Below 90 ^{o}F (32 ^{o}C)

Sections over 75mm - Air Cool To Below 90 ^{o}F (32 ^{o}C)

*Actual holding time should be long enough to ensure that the part is heated thoroughly through out its section

Age Hardening

Material in the solution annealed condition may be age hardened as follows:-

Condition	Heat to ±15 ^{o}F	Heat to ±9 ^{o}C		Hold for Hours		Cool To Below 90 ^{o}F (32 ^{o}C)
H900 (H480)	900 ^{o}F	480 ^{o}C		1		Air
H925 (H495)	925 ^{o}F	495 ^{o}C		4		Air
H1025 (H550)	1025 ^{o}F	550 ^{o}C		4		Air
H1075 (H580)	1075 ^{o}F	580 ^{o}C		4		Air
H1100 (H595)	1100 ^{o}F	595 ^{o}C		4		Air
H1150 (H620)	1150 ^{o}F	620 ^{o}C		4		Air
H1150M (H620M)*	1400 ^{o}F	760 ^{o}C		2		Air
Plus	1150 ^{o}F	620 ^{o}C		4		Air
H1150D (H620D)*	1150 ^{o}F	620 ^{o}C		4		Air
Plus	1150 ^{o}F	620 ^{o}C		4		Air

*Denotes Double Overaged

Notes on Heat Treatment And It's Effect On Structure - Corrosion Resistance Etc.

The martensitic transformation temperature range for this grade is:-

M_s - 270 °F (132 °C)

M_f - 90 °F (32 °C)

Therefore to ensure complete transformation to martensite, it is most important that parts are always cooled to below 90 °F (32 °C) within 24 hours following Solution Annealing and before Age Hardening Treatment which should also be followed by an air cool to below 90 °F (32 °C).

The age hardening tempers the martensite resulting in an improvement in toughness. The higher the ageing temperature the more refined the martensite leading to greater ductility but slightly lower strength.

N.B. Temperature control is critical during age hardening and any variations outside the given range could lead to less than satisfactory results.

In the solution annealed condition resistance to stress corrosion cracking is low - improving at age hardening temperatures from 1025 °F (550 °C) upwards to a maximum at 1150 °F (620 °C) double aged.

Dimensional Changes During Heat Treatment

Age hardening results in a slight dimensional contraction as follows:-

Condition A to condition H900 (H480) - contraction 0.0004/0.0006 M/M

Condition A to condition H1150 (H620) - contraction 0.0009/0.0012 M/M

Machining

Machinability in the solution annealed condition is similar to 302 and 304 austenitic stainless steel grades.

Machinablity in the H900 (H480) condition is limited, improving as the age hardening temperature is increased to optimum machinability similar to 304 austenitic stainless steel grade in the H1150 (H620) condition.

Removing Heat Tint

The heat tint formed during age hardening, whilst having little effect on corrosion resistance, may be removed when required for appearance purposes by pickling or electro polishing.

Elevated Temperature Use

Excellent oxidation resistance up to 1100 °F (540 °C).

Exposure to temperature range 600 - 900 °F (290 - 480 °C) long term may result in reduced toughness but this can sometimes be minimilized by using higher ageing temperatures. As a general guide for short term exposure at elevated temperatures the ageing temperature should be at least 50 °F (28 °C) above the working temperature.

Welding

May be welded satisfactorily by shielded fusion and resistance welded processes, however oxyacetylene welding is not recommended due to the posibility of carbon pick up Filler metal when required should be similar to the parent metal if strength is important otherwise standard austenitic stainless filler wire 308L may be satisfactory. Pre-heating is not generally required.

Welding in the solution annealed condition may be carried out satisfactorily, however welding in the H1150 (H620) condition reduces the effects of high welding stresses.

Following welding in the solution annealed condition, parts can be directly age hardened as required, however those in the H1150 (H620) condition should be re-solution annealed and then age hardened as required.