ATI Waspaloy* Alloy

INTRODUCTION

The alloy is a high strength, nickel base, precipitation hardening alloy which gains its high strength through the precipitation of gamma prime as a result of titanium and aluminum additions and through solid solution strengthening from additions of chromium, cobalt, and molybdenum. Precipitated carbides provide additional strengthening by pinning grain boundaries which reduce grain boundary sliding at elevated temperatures. The alloy is used for critical parts that require high strength at elevated temperatures. It is produced by vacuum induction melting (VIM) followed by vacuum arc remelting (VAR) and/or electroslag remelting (ESR). Applications include turbine and compressor discs, shafts, spacers, turbine cases, fasteners and other miscellaneous hardware.

Super Waspaloy alloy is a higher strength, thermo-mechanically processed grade that has slightly lower carbon content and higher titanium and aluminum contents.

SPECIFICATIONS

- AMS 5704 - Forgings: solution, stabilization, and precipitation heat treated
- AMS 5706 - Forgings, bars, and rings: solution heat treated
- AMS 5707 - Forgings, bars, and rings: solution, stabilization and precipitation heat treated
- AMS 5708 - Forgings and bars: solution heat treated
- AMS 5709 - Forgings and bars: solution, stabilization and precipitation heat treated

PHYSICAL PROPERTIES

Melting Range:
2,425 to 2,565 ºF (1,329 to 1,407 ºC)

Density:
0.296 lbs/in^3 (8.20 gm/cc)

HEAT TREATMENT

Solution treatment is at 1,825 to 1,900 0F (996 to 1,038 ºC), 4 hours, water or oil quench or 1,975 ºF (1,079 ºC), ½ or 4 hours, air cool. Stabilization treatment is 1,550 ºF (843 ºC), 4 or 24 hours, air cool. Aging is at 1,400 ºF (760 ºC) for 16 to 24 hours, air cool.

HARDNESS

The hardness in the fully heat treated condition ranges from 34 to 44 Rockwell C.

OXIDATON & CORROSION RESISTANCE

The alloy has good oxidation resistance up to 1,600 ^{0}F (871 ^{0}C) for intermittent service where thermal cycling exists, and up to 1,900 ^{0}F (1,038 ^{0}C) for continuous service in atmospheres encountered in jet engines. The alloy has excellent resistance to stress corrosion cracking and adequate hot corrosion resistance.

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FORGEABILITY/FORMABILITY

The alloy is hot worked from 1,850 to 2,150 ^{0}F (1,010 to 1,177 ^{0}C). Final forging reductions should be large enough to prevent critical strains, which result in catastrophic grain growth during solution annealing. The alloy should be cold formed in the solution treated conditions. Because of its high rate of work hardening, frequent anneals are necessary for severe cold forming operations.

MACHINABILITY

The alloy is difficult to machine in all heat treated conditions. The optimum condition for most machining operations is in the solution treated and partially aged condition where the hardness is about 30 Rockwell C. Sharp tools and rigid setups are required and positive cuts should be made using a minimum of 0.015” depth of cut to prevent work hardening. Speeds must not be too high to prevent excess heating and poor tool life.

WELDABILITY

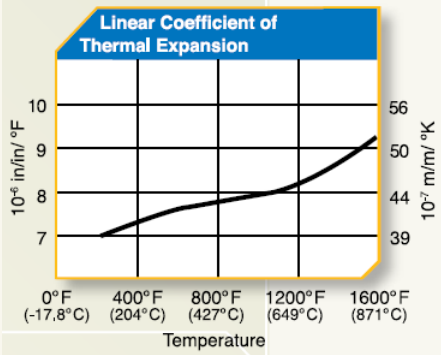
The welding of this alloy is difficult. Fusion welding should be performed in the solution treated condition using inert gas welding techniques and Waspaloy filler metal. Part restraint should be minimized. In some applications, the components are overaged prior to welding to minimize cracking. After welding or brazing, the assemblies should be re-solution annealed and aged.

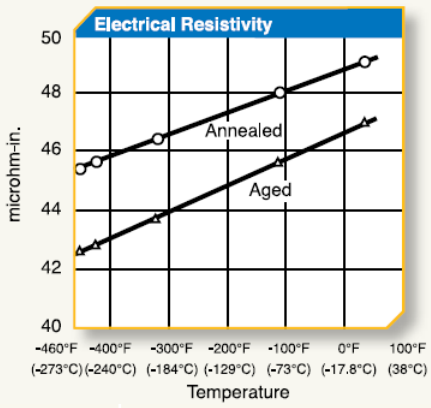
SPECIAL PRECAUTIONS

All lubricants and coolants, particularly sulfur-bearing, should be removed prior to heat treating or brazing. Forgings or parts that have been heat treated in oxidizing or sulfurous atmospheres should be machined to remove all surface attack.

Chemical Composition

	C	Mn	Si	S	P	Cr	Ni	Co	Fe	Mo	Ti	Al	B	Zr
% w/w, min.	0.03	-	-	-	-	18.00	Bal	12.0	-	3.5	2.75	1.2	0.003	0.02
% w/w, max.	0.10	0.10	0.15	0.015	0.015	21.00	-	15.0	2.0	5.0	3.25	1.6	0.010	0.08





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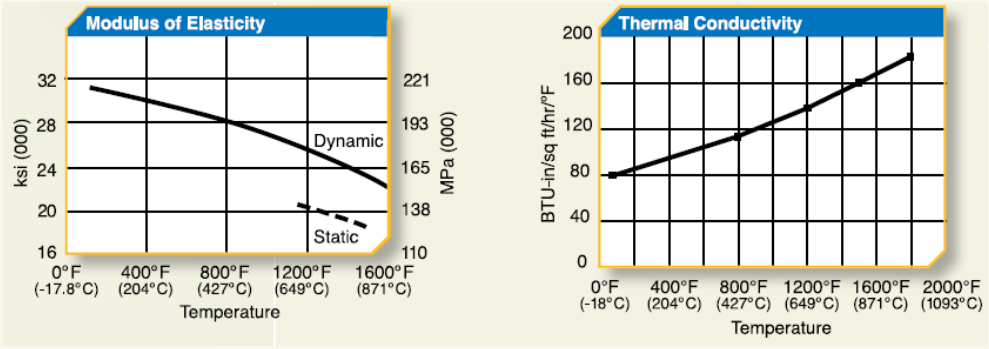

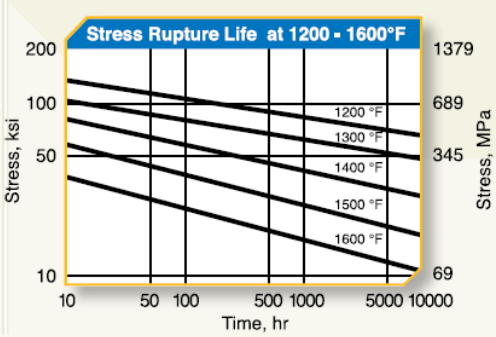

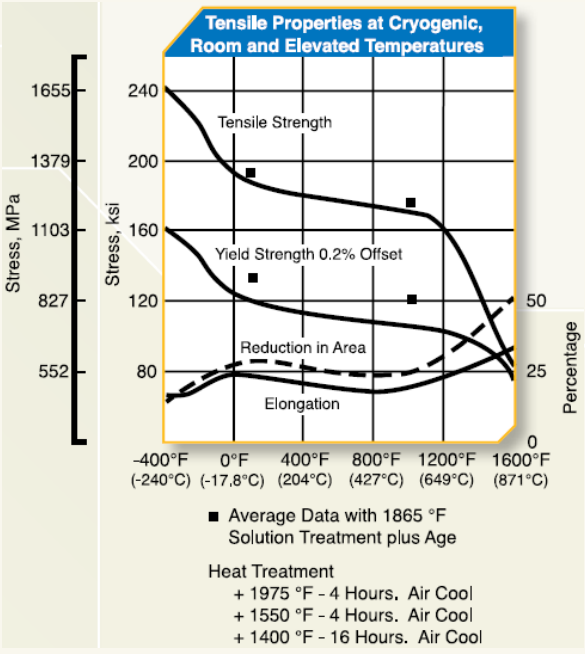

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