

ATI 35N™ ALLOY- UNS R30035

INTRODUCTION

ATI 35N is a multi-phase nickel-cobalt-chromium-molybdenum alloy that can be heat treated to achieve very high strength, while maintaining excellent low temperature toughness, ductility and corrosion resistance. To achieve tensile strength levels of 260 to 300 ksi (1793 to 2069 MPa), the alloy is cold worked and precipitation hardened. ATI 35N alloy has excellent corrosion resistance in various chloride environments, as well as mineral acids (nitric, hydrochloric and sulfuric). Additionally, the alloy has exceptional resistance to crevice corrosion in seawater and sulfide stress cracking in severe downhole environments. Typical applications are found in medical, aerospace, oil & gas, and chemical processing. A maximum service temperature of 750F (400°C) is suggested.

SPECIFICATIONS

AMS 5758 - VIM-VAR Bar, Solution heat treated at 1900-1925°F (1040-1050°C) for 4 to 8 hours.

AMS 5844 -VIM-VAR Bar, Solution heat treated at 1900-1925°F (1040-1050°C) for 4 to 8 hours and Work Hardened.

AMS 5845 - VIM-VAR Bar, Solution heat treated at 1900-1925°F (1040-1050°C) for 4 to 8 hours, Work Hardened plus Aged at 1000-1200°F (538-649°C) for 4 hours.

NACE MR0175 / ISO 15156 – Petroleum and Natural Gas Industries

ASTM F-562 - Surgical Implant Applications

BS 7252-6 Surgical Implant Applications

ISO 5832-6 Surgical Implant Applications

CHEMICAL COMPOSITION

Composition Range (UNS R30035)			
Element	Wt. %	Element	Wt. %
Cobalt	30.0 minimum	Chromium	19.0 – 21.0
Nickel	33.0 – 37.0	Molybdenum	9.0 – 10.5
Titanium	1.0	Iron	1.0
Carbon	0.025	Manganese	0.15
Phosphorous	0.015	Sulfur	0.010
Silicon	0.15		
Maximum % unless a range is indicated.			

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Technical Data Sheet
PHYSICAL PROPERTIES

Melting Range	2400-2625°F	1315-1440°C
Modulus of Elasticity, RT ²	34 x 10 ⁶ psi	234 X 10 ³ MPa
Poisson's Ratio	0.4	0.4
Coefficient of Thermal Expansion ¹	7.4 x 10 ⁻⁶ /°F	13.5 X 10 ⁻⁶ /°C
Electrical Resistivity @ RT ²	40.7 μΩ in.	103.3 μΩ cm
Thermal Conductivity ^{1,2}	7.77 BTU/hr-ft-°F	13.4 W/m-K
Density	0.304 lb/in ³	8.41 g/cm ³
Relative Magnetic Permeability	1.0009μ	1.0009μ
Specific Heat	0.18 BTU/lb-°F	753 J/kg-K
¹ Temperature range 68°F – 212°F (20°C - 100°C)		
² CW + Aged		

HEAT TREATING

After solution annealing at 1900-2000F (1038-1093°C) followed by working hardening, ATI 35N alloy can be precipitation hardened in the temperature range of 800-1500°F (427-816°C). For higher strength mechanical properties, cold worked ATI 35N alloy can be aged at 1000-1050°F (538-566°C) for 4 hours, followed by air cooling. For improved resistance to sulfide stress corrosion cracking, the material can be aged in accordance with NACE MR0175 / ISO 15156 described in Table 1. Additionally, it is noted that heat treatment at temperatures above 1300°F (700°C) helps to improve resistance to Hydrogen Embrittlement (HE).

Minimum time, hr.	Temperature, °F (°C)
4	1300 (704)
4	1350 (732)
6	1425 (774)
4	1450 (788)
2	1475 (802)
1	1500 (816)

Table 1. Heat Treatments in accordance with NACE MR0175 / ISO 15156.

UNS R30035 shall have a maximum hardness of 51 HRC if it is in the cold-reduced and high-temperature aged condition in accordance with one of the above ageing treatments.

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MECHANICAL PROPERTIES

Final mechanical properties for ATI 35N alloy are dependent on the amount of cold work, final size and heat treatment. An example of the effect of these variables is given in Figure 1.

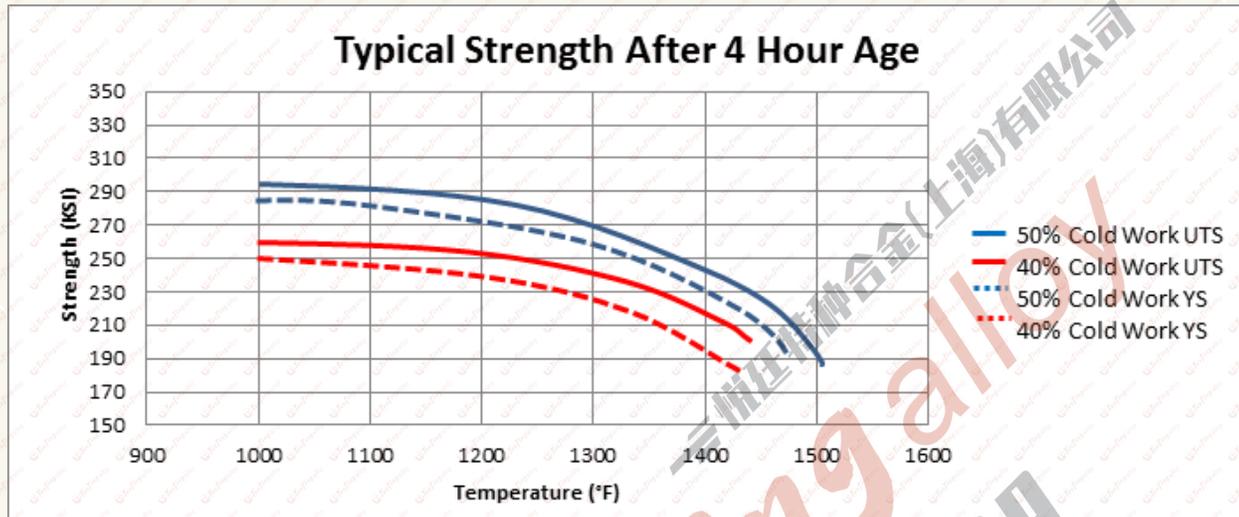


Figure 1. Effect of Cold Work and Aging Temperature on Mechanical Properties for ATI 35N™ alloy.

The following table lists the **Minimum Property Requirements** for industry specifications commonly requested.

Specification	Condition	0.2% Yield Strength Ksi (MPa)	Tensile Strength Ksi (MPa)	Elongation %	Reduction of Area %	Hardness HRC
AMS 5844 ¹	Solution Heat Treated and Work Hardened	230 (1585)	260 (1795)	8	35	38 min
AMS 5845 ²	Solution Heat Treated and Work Hardened and Aged	230 (1585)	260 (1795)	8	35	44 min
Oil & Gas	CW + Age Hardened	240 (1655)	250 (1725)	4	20	51 max
Oil & Gas	CW + Age Hardened	200 (1380)	210 (1450)	6	20	51 max
Oil & Gas	CW + Age Hardened	190 (1310)	210 (1450)	10	20	51 max
Oil & Gas	CW + Age Hardened	180 (1240)	190 (1310)	15	50	51 max

¹AMS 5844 material is supplied in the cold drawn or pilgered conditions, “capable of” full strength after aging.

²AMS 5845 and NACE MR0175/ISO 15156 materials are supplied in the aged condition.



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CORROSION RESISTANCE

ATI 35N alloy maintains excellent corrosion resistance in the fully hardened condition. Under 'Materials for use in H₂S containing environments in oil and gas production', International standard NACE MR0175 / ISO 15156 lists UNS R30035 suitable for equipment and components, in any combination of temperature, H₂S partial pressure, chloride concentration and pH that occurs in production environments. For spring applications, no limits exist on individual parameters, but note that some combinations of parameter values may not be acceptable.

MACHINABILITY

Parameters for machining ATI 35N alloy in a high strength condition are similar to other nickel-cobalt-chromium alloys such as Waspalloy®, which is a widely used machinability standard for Ni-Co-Cr alloys.

WELDABILITY

ATI 35N alloy is readily welded in the solution annealed condition using similar techniques as for 300 series stainless steels. The same preparations and precautions used for 300 series stainless steels should also be used for ATI 35N welding.

PRODUCT FORMS

ATI 35N alloy product forms include: bar, rod, billet, wire, tube and flat products. Inquire for your specific sizes and strengths.

CONTACT INFORMATION

For further assistance on ATI 35N™ Products, contact:

United States
ATI Specialty Materials at 1-800-841-5491 or ATI Flowform +1 978-667-0202

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www.ATImetals.com.

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