

ATI 600-MIL® Ultra High Hard Specialty Steel Armor

INTRODUCTION

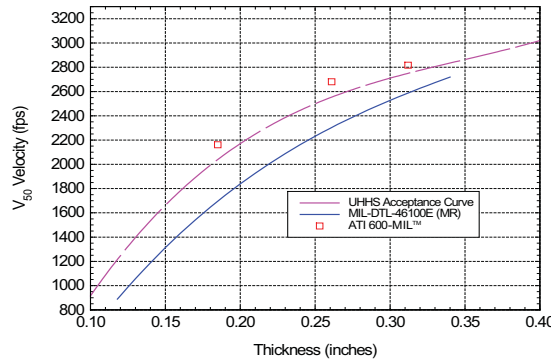
ATI 600-MIL® Ultra High Hard Specialty Steel is wrought Ni-Cr-Mo specialty steel designed for armor applications. The balanced composition of the alloy lends itself to good toughness relative to other “Ultra High Hard” alloys while maintaining ballistic resistance that satisfy demanding requirements.

Due to the unique composition of ATI 600-MIL®, liquid-quenching is not required to achieve the high hardness of this alloy rather; the high hardness is achieved via air-cooling. These processing practices result in low residual stresses leading to minimal plate distortion after mechanical cutting. Thermal cutting may produce some distortion, but is typically less than when thermally cutting liquid-quenched materials.

BALLISTIC RESULTS

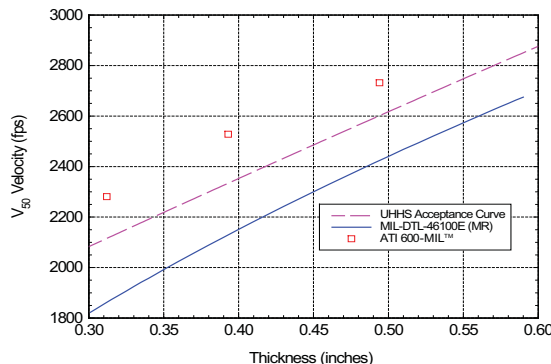


**ATI 600-MIL® vs. UHHS Acceptance Curve
.30 AP M2 @ 30 Deg**



Typical ballistic results of ATI 600-MIL® against 30 Cal. AP M2 projectile. (Courtesy of Army Research Labs).

**ATI 600-MIL® vs. UHHS Acceptance Curve
.50 AP M2 @ 30 Deg**



Typical ballistic results of ATI 600-MIL® against 50 Cal. AP M2 projectile. (Courtesy of Army Research Labs).

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MECHANICAL PROPERTIES

Typical mechanical property data for ATI 600-MIL® specialty steel is included below. This data represents an average of results for 0.275 in. (7 mm) and 0.199 in. (5 mm) plate.

Hardness

Steel will re-harden in the 574 to 634 BHN range.

Flatness

ATI 600-MIL® specialty steel exceeds the flatness requirement referenced in ASTM A6.

Typical Tensile Properties at Room Temperatures:

L-Direction: yield 190 ksi UTS 310 ksi Elong. 12.5%
 T-Direction: yield 195 ksi UTS 310 ksi Elong. 12.0%

Physical Properties

Density:
 7.850g/cm³ (0.285lbm/in³)

Coefficient of Thermal Expansion:

°F (68°F-212°F): 6.5x10⁻⁶
 °C (20°C-100°C): 11.6x10⁻⁶

FABRICATION

Cutting

Abrasive, water-jet and saw cutting are acceptable methods that typically do not create a heat affected zone (HAZ). Thermal cutting methods such as plasma, laser, and torch cutting may create a HAZ.

ATI 600-MIL® plate should not be sheared due to its high strength and moderate toughness. Attempts to shear this material could create a serious safety hazard.

Machining

ATI 600-MIL® plate can be drilled in the hardened condition by using high speed or carbide tipped drill bits. Because ATI 600-MIL® plates have a high work hardening rate, it is important that the work piece be rigidly supported to insure that positive feed pressure is maintained continuously. Interrupted feed pressure will allow work hardening thereby rendering drilling more difficult. Heavy feeds and slow speeds are preferred.

Cold Forming

Cold forming is not recommended.

Hot Forming

Hot forming is recommended with the following guidelines:

1. Plate should be heated to the 1550°F to 1650°F (843°C to 899°C) temperature range prior to forming.
2. To maintain ballistic quality, toughness, and metallurgical integrity, the temperature of the plate should not exceed 1650°F (899°C.)
3. Grind edges and create round corners.
4. After forming allow steel to cool uniformly with unrestricted air flow (still air recommended) to the top and bottom of plate until plate temperature is <300°F (149°C.) Do not cool using water quenching or forced air cooling methods. Steel will re-harden to approximately 650 BHN.

CHEMICAL COMPOSITION

Element	Composition* (weight %)
C	0.42 – 0.52
Ni	3.75 – 4.25
Cr	1.00 – 1.50
Mo	0.22 – 0.37
Mn	0.20 – 1.00
Si	0.20 – 0.50
P	0.020 (max)
S	0.005 (max)
Fe	Balance residual elements per MIL-A-46100D requirements

*Composition shown is typical; specifics can vary.



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Welding

Welding is not recommended.

Heat Treatment

ATI 600-MIL® plate is delivered in the fully hardened condition. A low temperature (400°F (149°C) maximum) tempering treatment may be used if increased toughness is desired.

ATI 600-MIL® plate can be supplied in the as-annealed condition if stipulated but hardening of the material to achieve ballistic performance then becomes the sole responsibility of the user.

AVAILABLE FORMS

ATI 600-MIL® specialty steel is available in standard mill plate gauges from 0.1875" to .625" (4.762mm to 50.8mm.) Please inquire for sheet gauges.

CONTACT INFORMATION

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