A new steel developed specifically for handmade knives. ApexUltra is a steel truly worth of handcrafted knives. It is a low alloy design that is forgeable, forge-weldable, and its fine carbides make the steel relatively easy to finish and sharpen. With its high purity and well-balanced alloy composition it has very high toughness in the 66+ HRC range along with excellent edge retention. This product offers an excellent combination of properties for knives. For more information visit: https://www.apexultrasteel.com/

Chemical Composition

Carbon	**1.25%**
Tungsten	**2.60%**
Vanadium	**0.40%**
Chromium	**1.50%**
Manganese	**0.30%**
Silicon	**0.35%**

Thermal Treatments – Prior Processing

Forging

1120°C - 800°C 2050°F – 1475°F

Do not heat above 1120°C (2050°F) or the steel may get irreversibly damaged.

Cool slowly after forging to avoid air hardening and possible crack formation, this is especially important if subsequent heat treatments are not done immediately after forging.

Normalizing

Heat to 950°C (1750°F), hold for 15 minutes, air cool below 600°C (1100°F).

Grain Refining

Quickly heat up to 790°C (1450°F), hold for 10 minutes, air cool.

Can be performed 2-3 times to get smaller austenite grain sizes.

Annealing

Anneal by heating to 1450°F/790°C for 15 -30 minutes, cool at 100°F/hr (55°C/hr) to 1100°F/590°C. Cooling rate below 1100°F/590°C is not critical.

Stress Relieving

This process is for helping with the stresses generated during grinding, which reduces warping during heat treating. It is an optional heat treating step. Heat up to 590°C (1100°F), hold for 1 hour followed by slow furnace cooling.

Thermal Treatments – Austenitizing and Tempering

Hardening

Austenitize between 780 °C (1435°F) and 880°C (1615°F) depending on the intended hardness, hold for 10 minutes, quench in fast oil or medium fast oil.

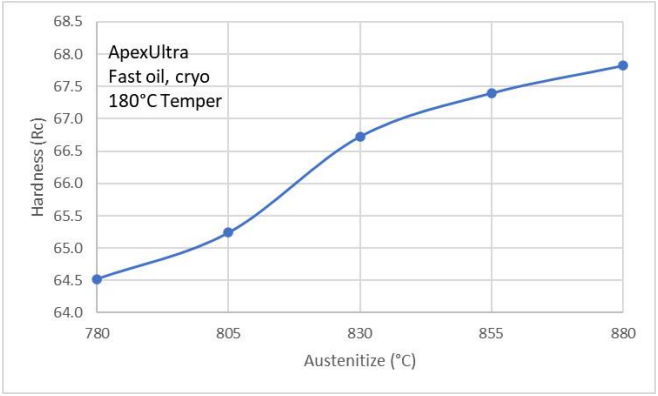
Cold Treatment

Cold treatment is optional but helps keeping retained austenite low especially if austenitized at higher temperatures.
Cool the steel immediately after quenching in the freezer, dry ice or liquid nitrogen and hold for 30 minutes.

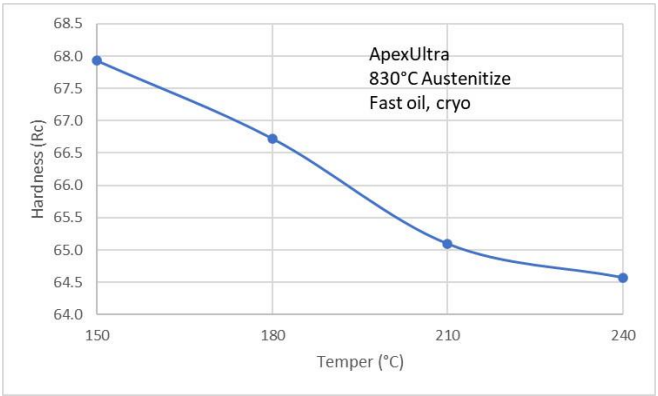
Tempering

Heat the steel up between 150° - 240°C (300°F – 460°F) after quenching to room temperature or after cold treatment. Process the tempering two times, 1 hour each, with cooling to room temperature in between.

Effect of Austenitizing temperature, constant tempering temperature



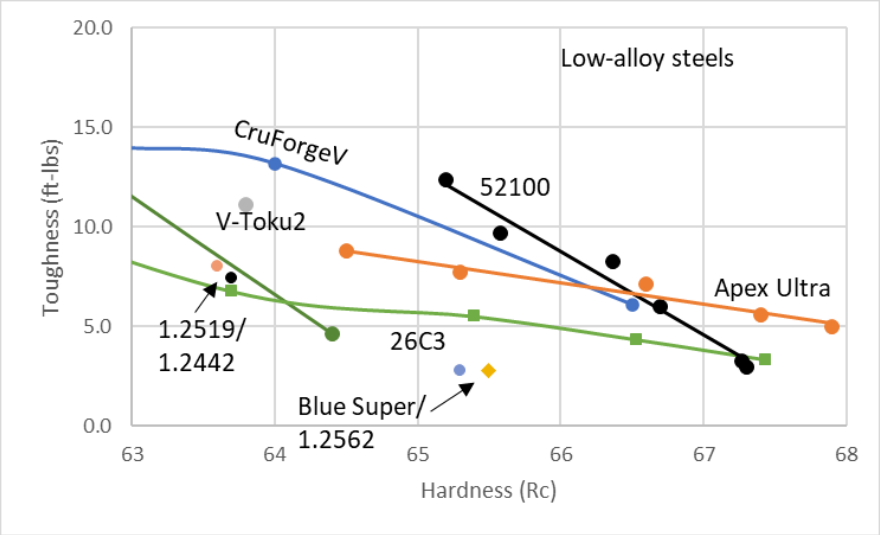
Effect of tempering temperature, constant Austenitizing temperature



Mechanical Properties

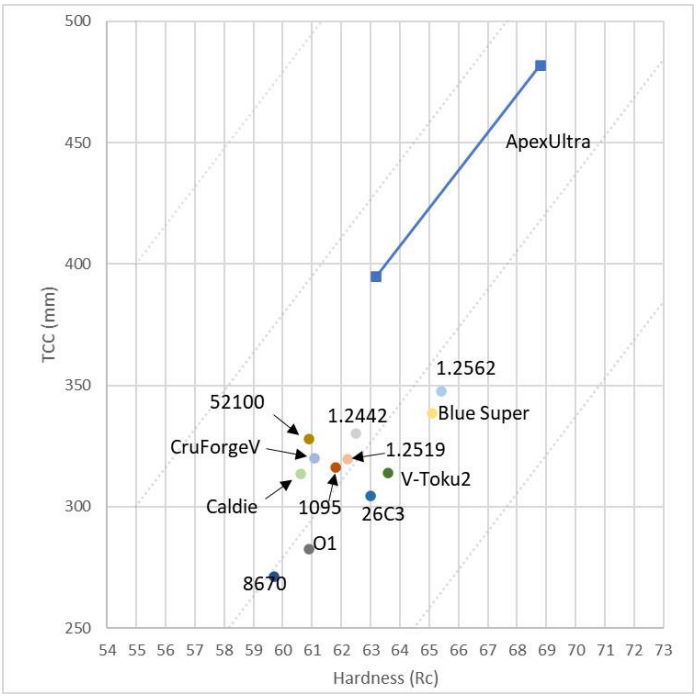
Toughness / Hardness

ApexUltra has an excellent hardness / toughness ratio, especially in the high hardness range where it outperforms other steels.



Edge Retention

ApexUltra with its combination of chromium-enriched iron carbides, tungsten carbides, and vanadium carbides, has significantly improved edge retention than other low alloy steels typically used by forging bladesmiths.



Practical heat treatment recommendations for the knifemaker:

For more detailed information check the knifesteelnerds article by Larrin Thomas:
https://knifesteelnerds.com/2022/09/06/how-to-heat-treat-apexultra-knife-steel/

Forge-Only Heat Treatment for both Forged or Stock Removal Blades

- Normalize at 1750°F/950°C (check with laser thermometer or tempilstik), air cool.
- Grain refine by heating to nonmagnetic and air cool.
- Anneal by heating to nonmagnetic and placing in vermiculite or another insulating media; additional heated steel bars can help slow cooling and make the steel softer.
- Heat to nonmagnetic and quench in oil. The combination of fine prior microstructure from the anneal, and grain-pinning carbide, means that a wide range of temperatures work from nonmagnetic up to 880°C/1615°F or potentially hotter. This makes the odds of success with a forge heat treatment very high.
- Temper at 300-450°F (150-240°C) depending on the desired hardness/toughness combination.

Forged Blades, Furnace Heat Treating

- Normalize at 1750°F/950°C for 10-15 minutes, air cool.
- Refine the grain by heating to 1450°F/790°C for 10 minutes, air cool
- Anneal by heating to 1450°F/790°C for 15 -30 minutes, cool at 100°F/hr (55°C/hr) to 1100°F/590°C. Cooling rate below 1100°F/590°C is not critical.
- Austenitize at 1525-1625°F (830-885°C) for 10-15 minutes, quench in oil.
- Temper at 300-450°F (150-240°C) depending on the desired hardness/toughness combination.

Stock Removal, Furnace

- Austenitize at 1525-1625°F (830-885°C) for 10-15 minutes, quench in oil.
- Temper at 300-450°F (150-240°C) depending on the desired hardness/toughness combination.
- Properties are not quite as good when heat treating from the as-received condition as from the 100°F/hr (55°C/hr) condition. Follow the “Forged Blades, Furnace Heat Treating” steps above starting with the normalizing treatment for the somewhat improved properties.