Technical Datasheet

CarTech® AerMet® 340 Alloy

Identification

U.S. Patent Number

• Patent Pending

Type Analysis

Single figures are nominal except where noted.

Carbon	0.33 %	**Chromium**	2.25 %
Nickel	12.00 %	**Molybdenum**	1.85 %
Cobalt	15.60 %	**Iron**	Balance

General Information

Description

CarTech AerMet 340 alloy possesses high hardness and strength while exhibiting exceptional toughness and ductility.

Applications

CarTech AerMet 340 alloy may be considered for use in applications such as structural tubing, structural members, drive shafts, springs, connecting rods, and crank shafts.

Corrosion Resistance

Although AerMet 340 alloy possesses some environmental resistance, it is not a stainless alloy and should be plated or coated with a rust preventative or oil to prevent corrosion.

Properties

Physical Properties

Density	0.2900	lb/in³
Mean CTE		
75 to 200°F, Annealed	5.60	x 10 ⁻⁶ in/in/°F
75 to 300°F, Annealed	5.74	x 10 ⁻⁶ in/in/°F
75 to 400°F, Annealed	5.88	x 10 ⁻⁶ in/in/°F
75 to 500°F, Annealed	6.01	x 10 ⁻⁶ in/in/°F
75 to 600°F, Annealed	6.13	x 10 ⁻⁶ in/in/°F
75 to 700°F, Annealed	6.23	x 10 ⁻⁶ in/in/°F
75 to 800°F, Annealed	6.35	x 10 ⁻⁶ in/in/°F
75 to 900°F, Annealed	6.44	x 10 ⁻⁶ in/in/°F
75 to 1000°F, Annealed	6.34	x 10 ⁻⁶ in/in/°F
75 to 200°F, Heat Treated	5.56	x 10 ⁻⁶ in/in/°F
75 to 300°F, Heat Treated	5.76	x 10 ⁻⁶ in/in/°F
75 to 400°F, Heat Treated	5.87	x 10 ⁻⁶ in/in/°F
75 to 500°F, Heat Treated	5.97	x 10 ⁻⁶ in/in/°F
75 to 600°F, Heat Treated	6.05	x 10 ⁻⁶ in/in/°F
75 to 700°F, Heat Treated	6.16	x 10 ⁻⁶ in/in/°F
75 to 800°F, Heat Treated	6.26	x 10 ⁻⁶ in/in/°F
75 to 900°F, Heat Treated	6.36	x 10 ⁻⁶ in/in/°F
75 to 1000°F, Heat Treated	6.44	x 10 ⁻⁶ in/in/°F

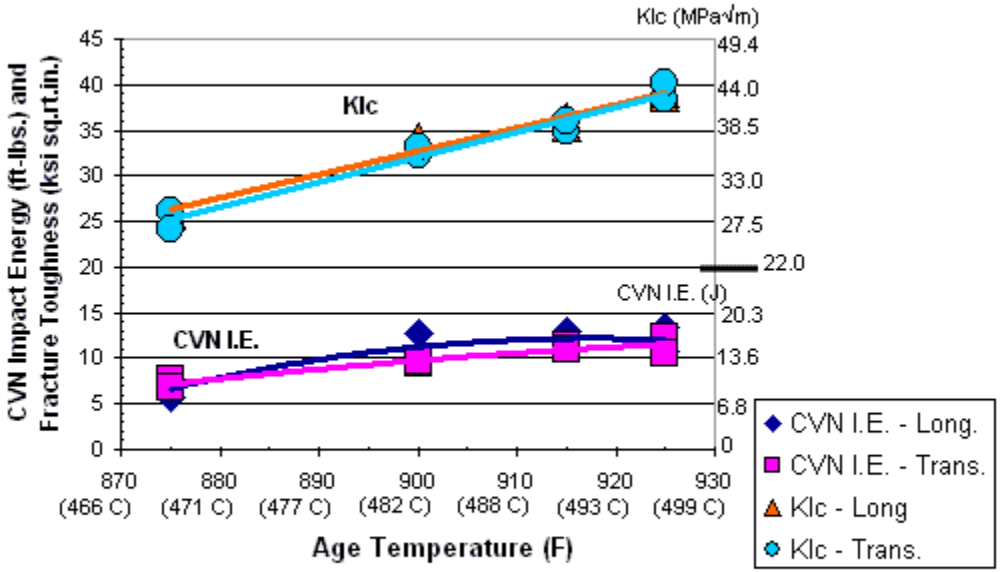
Mean Coefficient of Thermal Expansion

Temperature Range		Condition			
		Annealed		Heat Treated	
75°F to (°F)	25°C to (°C)	x 10^{-6}/°F	x 10^{-6}/°C	x 10^{-6}/°F	x 10^{-6}/°C
200	93	5.60	10.07	5.56	10.01
300	149	5.74	10.34	5.76	10.36
400	204	5.88	10.59	5.87	10.57
500	260	6.01	10.81	5.97	10.74
600	316	6.13	11.03	6.05	10.90
700	371	6.23	11.22	6.16	11.08
800	427	6.35	11.44	6.26	11.26
900	482	6.44	11.59	6.36	11.45
1000	538	6.34	11.41	6.44	11.59

Annealed: 1250°F (677°C) (16 h) Air Cool.
Heat treated: 1775°F (968°C) (1 h) Air Cool + -100°F (-73°C) (1 h) Air Warm + 900°F (482°C) (2.5 h) Air Cool + -100°F (-73°C) (1 h) Air Warm + 900°F (482°C) (2.5 h) Air Cool + -100°F (-73°C) (1 h) Air Warm.

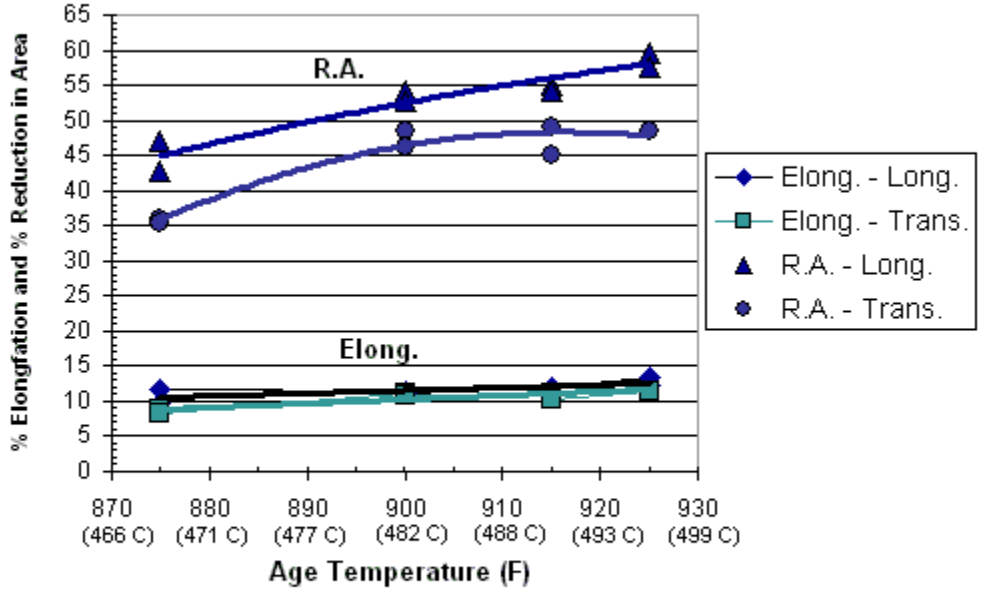
Typical Mechanical Properties

Effect of Age Temperature on CVN Impact Energy and Fracture Toughness of AerMet 340 Alloy



Heat Treatment = 1775°F (968°C) (1 h) Air Cool + -100°F (-73°C) (1 h) Air Warm + 875°, 900°, 915° or 925°F (468, 482, 491 or 496°C) (2.5 h) Air Cool + -100°F (-73°C) (1 h) Air Warm + 875°, 900°, 915° or 925°F (468, 482, 491 or 496°C) (2.5 h) Air Cool + -100°F (-73°C) (1 h) Air Warm.

Effect of Age Temperature on Elongation and Reduction in Area of AerMet® 340 Alloy



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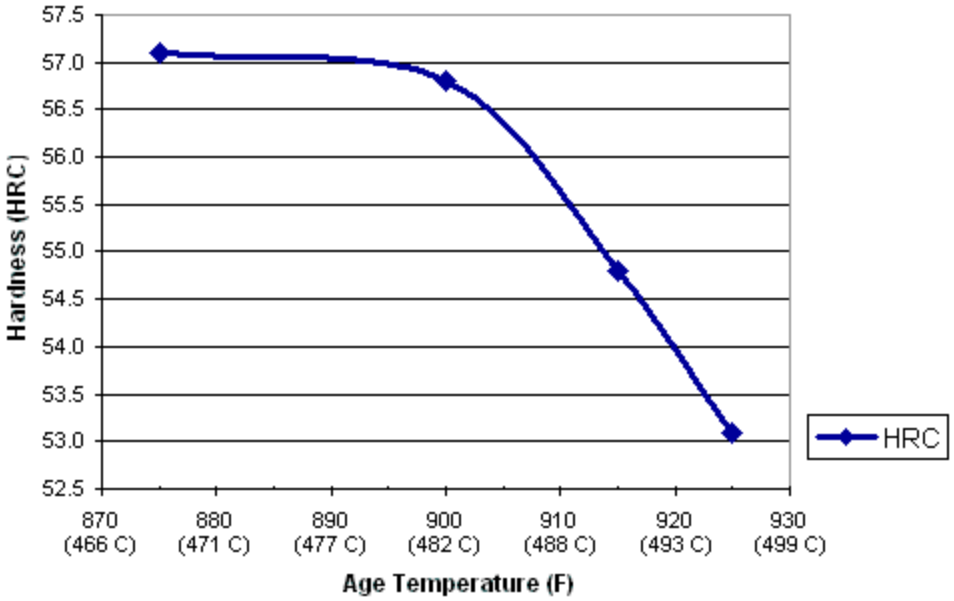
Effect of Age Temperature on Hardness of AerMet 340 Alloy



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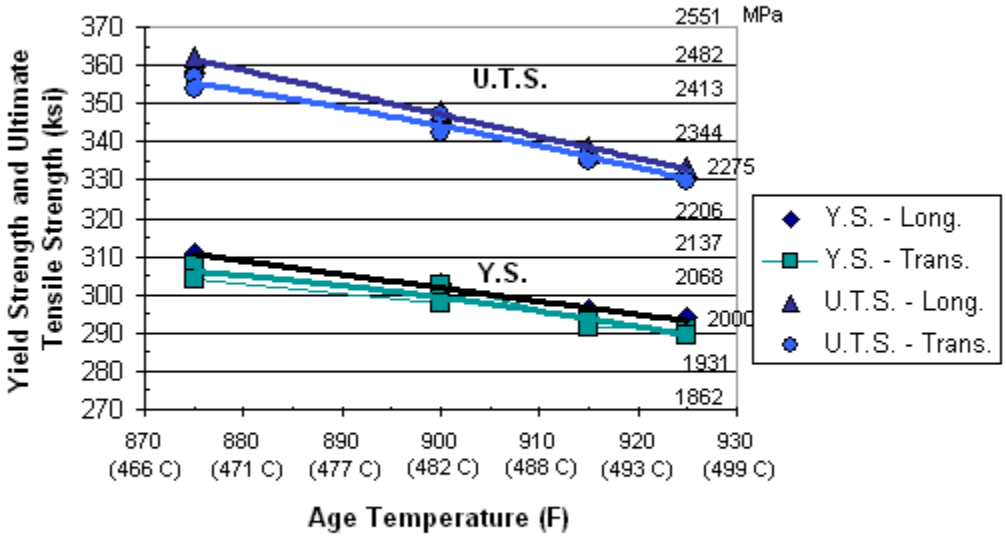
Effect of Age Temperature on Yield Strength and Ultimate Tensile Strength of AerMet® 340 Alloy



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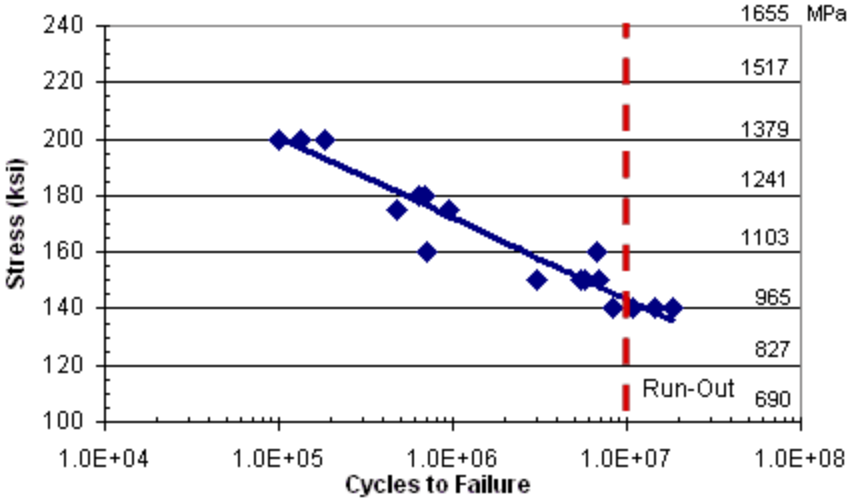
Rotating Bending (R = -1, Kt = 1) Fatigue Life of AerMet 340 Alloy



Heat Treament = 1775°F (1 h) Air Cool + -100°F (1h) Air Warm + 900°F (2.5h) Air Cool + -100°F (1 h) Air Warm + 900°F (2.5 h) Air Cool + -100°F (1 h) Air Warm.

Typical Room Temperature Mechanical Properties – AerMet® 340 Alloy
Aged

Orientation	0.2% Yield Strength		Ultimate Tensile strength		% Elongation in 4D	% Reduction of Area	Charpy V-notch		Fracture Toughness		HRC
	ksi	MPa	ksi	MPa			Ft.-lbs.	J	ksi√in	MPa√M	
Long.	300	2068	345	2379	11	53	11	15	34	37	56.5

Heat Treatment = 1775°F (1 h) Air Cool + -100°F (1 h) Air Warm + 900°F (2.5 h) Air Cool + -100°F (1 h) Air Warm + 900°F (2.5 h) Air Cool + -100°F (1 h) Air Warm.

Typical Room Temperature Mechanical Properties – AerMet® 340 Alloy
Annealed

Orientation	0.2% Yield Strength		Ultimate Tensile strength		% Elongation in 4D	% Reduction of Area	Charpy V-notch		HRC
	ksi	MPa	ksi	MPa			Ft.-lbs.	J	
Long.	155	1069	202	1393	18	57	25	34	42.0

Heat Treatment = 1250°F (16 h) Air Cool

Heat Treatment

Decarburization

Like other carbon-bearing high strength alloys, AerMet 340 alloy is subject to decarburization during hardening. Heat treatment should take place in a neutral atmosphere furnace, salt bath or vacuum. Decarburization should be determined by comparing the surface and internal hardness of a small test cube for proper response. Metallographic determination of decarburization is not recommended for this alloy.

Normalizing

AerMet 340 alloy can be normalized by heating to 1775°F (968°C), holding for one hour and air cooling to room temperature. Optimum softening for machining is obtained by following the 1775°F (968°C) normalize with a 16 hour 1250°F (677°C) overage anneal.

Annealing

AerMet 340 alloy is softened by using a 1250°F (677°C) overage anneal for 16 hours. The optimum annealed hardness of 37-42 HRC maximum is obtained following this anneal.

Solution Treatment

The solution treatment temperature range is 1775°F +/- 25°F (968°C +/- 14°C) for 1 hour. The solution temperature must be monitored by a thermocouple attached to the load.

Quenching

Water quenching is not recommended.

Proper quenching practice is essential for AerMet 340 alloy. The alloy should be cooled from the solution temperature to 150°F (66°C) in 1 to 2 hours to develop optimum properties. Individual sections larger than 2 inch (5 cm) diameter or 1 inch (2.5 cm) thick (plate) must be quenched in oil in order to obtain 150°F (66°C) in 1 to 2 hours. The cooling rate of the furnace load must be monitored by a thermocouple attached to the hottest spot in the load to ensure that the 2 hour cool to 150°F (66°C) is obtained.

Cold Treatment

Following cooling to room temperature, to obtain the full toughness capability, AerMet 340 alloy should be cooled to -100°F (-73°C) and held for 1 hour. The parts can then be air warmed to room temperature.

Straightening

AerMet 340 alloy exhibits minimal size change during heat treatment; however, for some parts, mechanical straightening to compensate for distortion during heat treatment is appropriate.

Prior to straightening, a low temperature stress relief at 350/400°F (177/204°C) for 5 hours following the refrigeration operation will provide an optimal combination of ductility and yield strength for the mechanical straightening operation.

Age

The typical aging treatment for AerMet 340 alloy is a single age at 900°F +/- 10°F (482°C +/- 6°C) for 3-8 hours followed by air cooling to room temperature. Parts made from AerMet 340 alloy should never be aged at a temperature below 875°F (468°C).

Alternative double aging treatments can also be used with a refrigeration step between the aging treatments. An additional refrigeration treatment can also be performed after the final age if desired.

Workability

Forging

Primary breakdown forging of AerMet 340 alloy should be done at a maximum starting temperature of 2250°F (1232°C). Finish forging should be done from 1800°F (982°C) with a finishing temperature below 1650°F (899°C) in order to optimize the final heat treated properties. Following forging, the parts should be air cooled to room temperature and then annealed. Following the anneal, the forgings should be normalized in order to restore properties to the dead zone.

Machinability

AerMet 340 alloy is somewhat more difficult to machine than 4340 at a hardness of Rockwell C 38. Carbide tools are recommended at 280 to 350 SFM. Following rough machining, if a stress relief is desired, stress relieve at 800°F (427°C) for 1 to 3 hours.

Other Information

Forms Manufactured

- Bar
- Billet
- Hollow Bar
- Plate
- Sheet
- Strip
- Wire

Technical Articles

- Toughness Index for Alloy Comparisons

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