CARPENTER TECHNOLOGY

DATASHEET

AerMet® 100

Applicable specifications: AMS 6478, 6532; McDonnell Douglas MMS 217, MIL HDBK-5
Associated specifications: UNS K92580

Type analysis

Single figures are nominal except where noted.

Iron	Balance	**Cobalt**	13.40 %	**Nickel**	11.10 %
Chromium	3.10 %	**Molybdenum**	1.20 %	**Carbon**	0.23 %

Forms manufactured

Bar-Rounds	**Billet**	**Hollow Bar**
Plate	**Sheet**	**Strip**
Weld Wire	**Wire**	

Description

AerMet 100 is an alloy possessing high hardness and strength combined with exceptional ductility and toughness. The alloy is designed for components requiring high strength, high fracture toughness, and exceptional resistance to stress corrosion cracking and fatigue.

Key Properties:

- High strength
- High fracture toughness
- High hardness
- Superior ductility

Markets:

- Aerospace and Defense
- Energy
- Industrial
- Transportation

Applications:

- Armor
- Actuators
- Ballistic components
- Drive shafts
- Fasteners
- Jet engine shafts
- Landing gear
- Ordnance
- Structural members
- Structural tubing

> AerMet 100

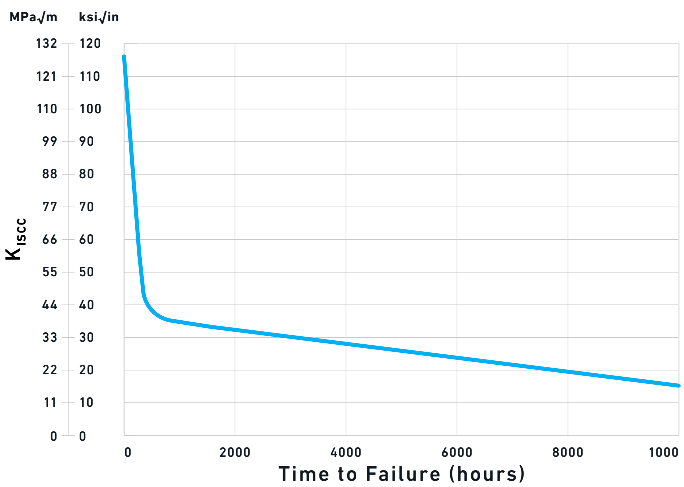
Corroison resistance

Important Note:
The following 4-level rating scale is intended for comparative purposes only. Corrosion testing is recommended. Factors that affect corrosion resistance include temperature, concentration, pH, impurities, aeration, velocity, crevices, deposits, metallurgical condition, stress, surface finish, and dissimilar metal contact.

Humidity	Restricted

STRESS CORROSION CRACKING PROPERTIES

Solution: 3.5 % NaCl.



> AerMet 100

Physical properties

PROPERTY		At or From	English Units	Metric Units
DENSITY		Room temperature	0.287 lb/in^3	7.94 g/cm^3
MEAN COEFFICIENT OF THERMAL EXPANSION	ANNEALED	75 to 200°F (25 to 93°C)	5.49 x 10^{-6} in/in/°F	9.88 x 10^{-6} length/length/°C
		75 to 300°F (25 to 149°C)	5.73 x 10^{-6} in/in/°F	10.31 x 10^{-6} length/length/°C
		75 to 400°F (25 to 204°C)	5.83 x 10^{-6} in/in/°F	10.49 x 10^{-6} length/length/°C
		75 to 500°F (25 to 260°C)	5.92 x 10^{-6} in/in/°F	10.66 x 10^{-6} length/length/°C
		75 to 600°F (25 to 316°C)	6.01 x 10^{-6} in/in/°F	10.82 x 10^{-6} length/length/°C
		75 to 700°F (25 to 371°C)	6.10x 10^{-6} in/in/°F	10.98 x 10^{-6} length/length/°C
		75 to 800°F (25 to 427°C)	6.20 x 10^{-6} in/in/°F	11.16 x 10^{-6} length/length/°C
		75 to 900°F (25 to 482°C)	6.29 x 10^{-6} in/in/°F	11.32 x 10^{-6} length/length/°C
		75 to 1000°F (25 to 538°C)	6.28 x 10^{-6} in/in/°F	11.30 x 10^{-6} length/length/°C
	HEAT TREATED	75 to 200°F (25 to 93°C)	5.55 x 10^{-6} in/in/°F	9.99 x 10^{-6} length/length/°C
		75 to 300°F (25 to 149°C)	5.77 x 10^{-6} in/in/°F	10.39 x 10^{-6} length/length/°C
		75 to 400°F (25 to 204°C)	5.88 x 10^{-6} in/in/°F	10.58 x 10^{-6} length/length/°C
		75 to 500°F (25 to 260°C)	6.00 x 10^{-6} in/in/°F	10.80 x 10^{-6} length/length/°C
		75 to 600°F (25 to 316°C)	6.08 x 10^{-6} in/in/°F	10.94 x 10^{-6} length/length/°C
		75 to 700°F (25 to 371°C)	6.16 x 10^{-6} in/in/°F	11.09 x 10^{-6} length/length/°C
		75 to 800°F (25 to 427°C)	6.25 x 10^{-6} in/in/°F	11.25 x 10^{-6} length/length/°C
		75 to 900°F (25 to 482°C)	6.34 x 10^{-6} in/in/°F	11.41 x 10^{-6} length/length/°C
		75 to 1000°F (25 to 538°C)	6.43 x 10^{-6} in/in/°F	11.57 x 10^{-6} length/length/°C
MODULUS OF ELASTICITY		—	28.2 x 10^3 ksi	—
ELECTRICAL RESISTIVITY		70°F (21°C)	259.0 ohm-cir-mil/ft	—
CRITICAL TEMPERATURE		AC1	1065°F	574°C
		AC3	1525°F	829°C

info@cartech.com | 610 208 2000

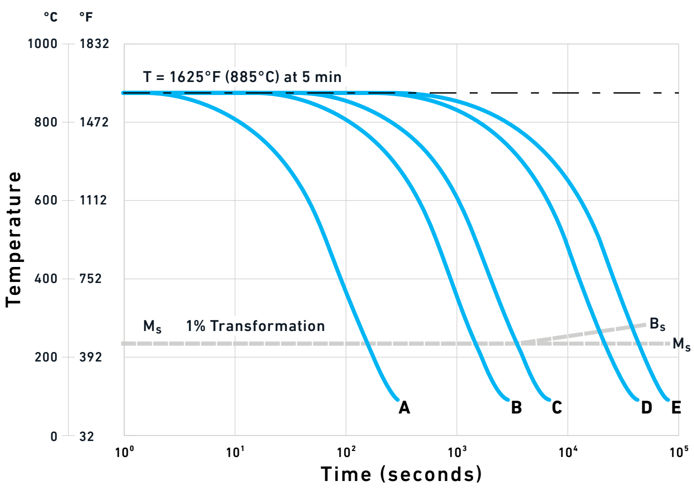
> AerMet 100

CONTINUOUS COOLING OF AERMET 100 SAMPLES

SAMPLE ID	COOLING TIME	M_s		B_s		HARDNESS
	SECONDS	°F	°C	°F	°C	HRC
A	200	437	225	—	—	55.5
B	2000	437	225	—	—	53.0
C	5000	437	225	—	—	52.5
D	28800	428	220	482	250	51.5
E	57600	423	217	500	260	51.5

FULL CONTINUOUS COOLING CURVE

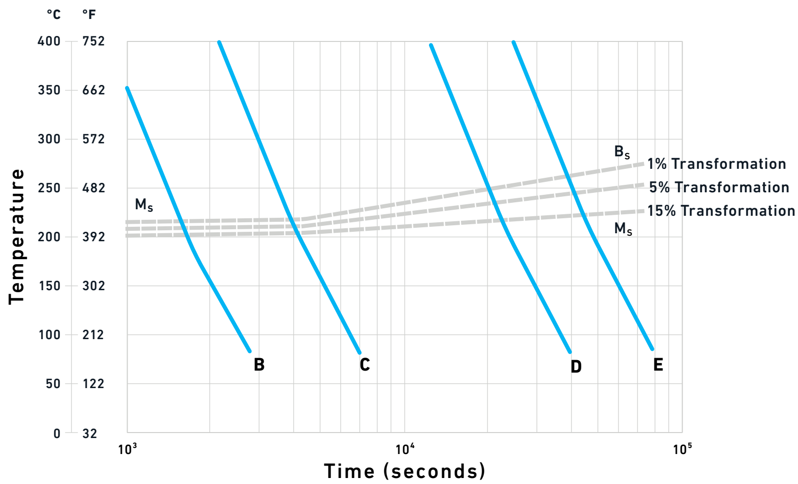
Including a line representing 1% transformation.



> AerMet 100

PARTIAL CONTINUOUS COOLING CURVE

This partial curve represents a critical region of the continuous cooling curve as well as the inclusion of 5 and 15% transformation lines.



Samples B and C: 0.12 in (3 mm) diameter x 0.39 in (10 mm) rod heated to 1625°F (885°C) at 360°F (200°C) per minute held at 1625°F (885°C) for 5 min quenched with helium gas.

Samples D and E: 0.12 in (3 mm) diameter x 0.31 in (8 mm) rod heated to 1625°F (885°C) at 360°F (200°C) per minute held at 1625°F (885°C) for 5 min quenched with helium gas.

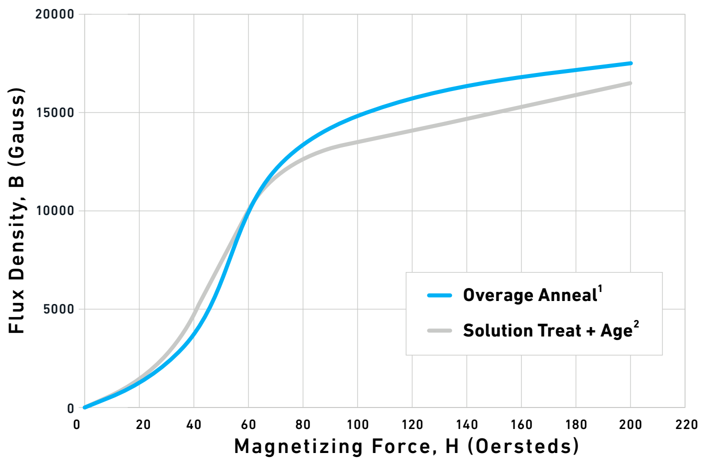
info@cartech.com | 610 208 2000

> AerMet 100

Magnetic properties

DC NORMAL MAGNETIC PROPERTIES

Overage annealed material: 1250°F (677°C) 16 hours, air cooled.
Solution treated and aged material: 1625°F (885°C) 1 hour, air cooled, refrigerated -100°F (-73°C), aged 900°F (482°C) 5 hours, air cooled.



[1] *μ max = 180, From H = 200 Oe, B_F = 11600 G, H_c = 52.0 Oe*

[2.] *μ max = 150, From H = 200 Oe, B_F = 10100 G, H_c = 39.5 Oe*

> AerMet 100

Typical mechanical properties

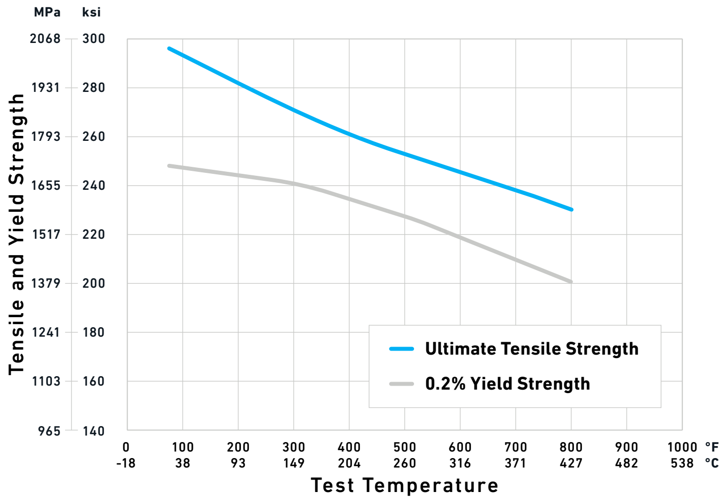
EFFECT OF ORIENTATION ON TYPICAL MECHANICAL PROPERTIES

ORIENTATION	YIELD STRENGTH		ULTIMATE TENSILE STRENGTH		ELONGATION	REDUCTION OF AREA	CHARPY V-NOTCH IMPACT ENERGY		FRACTURE TOUGHNESS K_{IC}	
	ksi	MPa	ksi	MPa	%	%	FT-LBS	J	ksi√in	MPa√M
Longitudinal	250	1724	285	1965	14	65	30	41	115	126
Transverse	250	1724	285	1965	13	55	25	34	100	110

Heat treatment: 1625°F (885°C) 1 hour, air cooled, refrigerated -100°F (-73°C) 1 hour, aged 900°F (482°C) 5 hours.

0.2% OFFSET YIELD STRENGTH AND ULTIMATE TENSILE STRENGTH VS. TEST TEMPERATURE

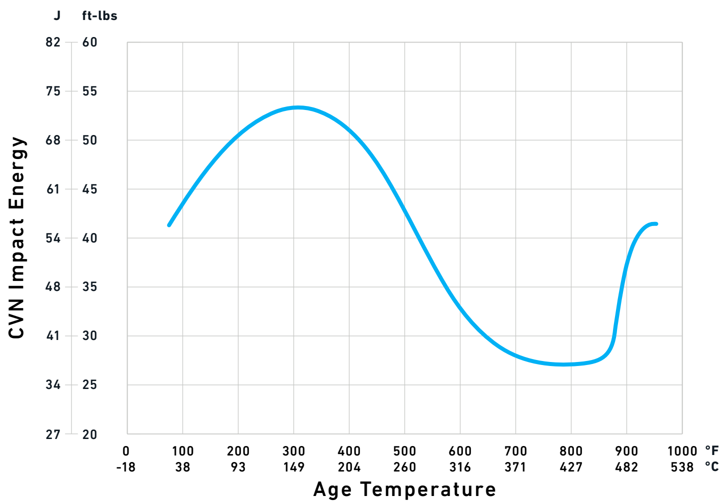
Heat treated 1625°F (885°C) 1 hour, vermiculite cooled, refrigerated -100°F (-73°C) 1 hour, air warmed, aged 900°F (482°C) 5 hours, air cooled.



> AerMet 100

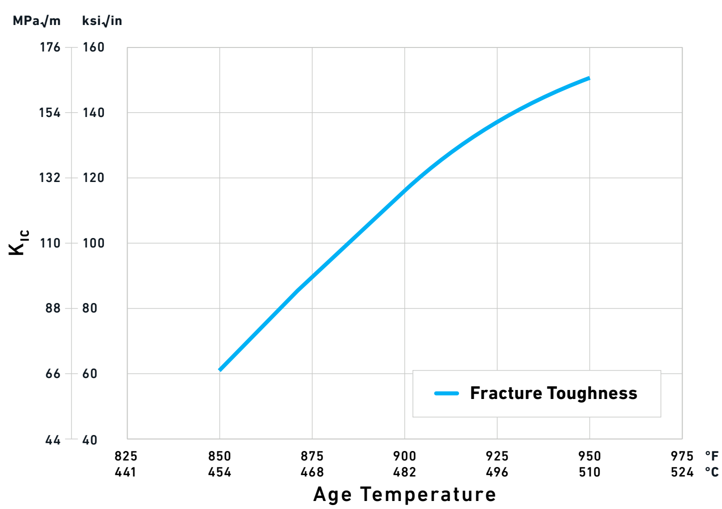
EFFECT OF AGING TEMPERATURE ON CHARPY V-NOTCH ENERGY

Longitudinal orientation: Heat treated 1625°F (885°C) 1 hour, air cooled, refrigerated -100°F (-73°C) 1 hour, air warmed, aged 5 hours, air cooled.



EFFECT OF AGING TEMPERATURE ON PLANE STRAIN FRACTURE TOUGHNESS

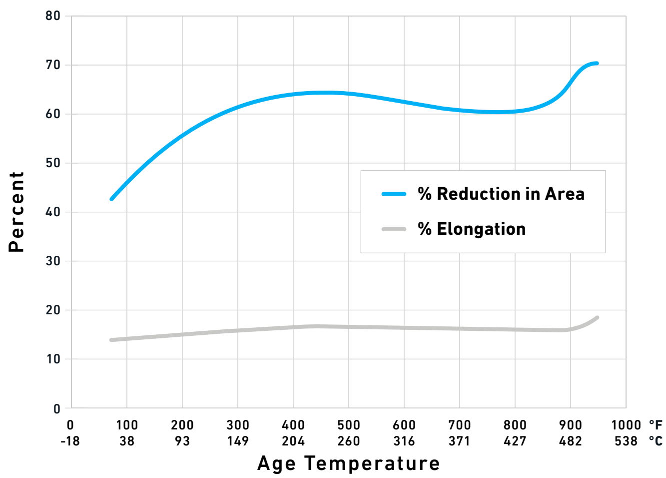
Longitudinal orientation: Heat treated 1625°F (885°C) 1 hour, air cooled, refrigerated -100°F (-73°C) 1 hour, air warmed, aged 5 hours, air cooled.



> AerMet 100

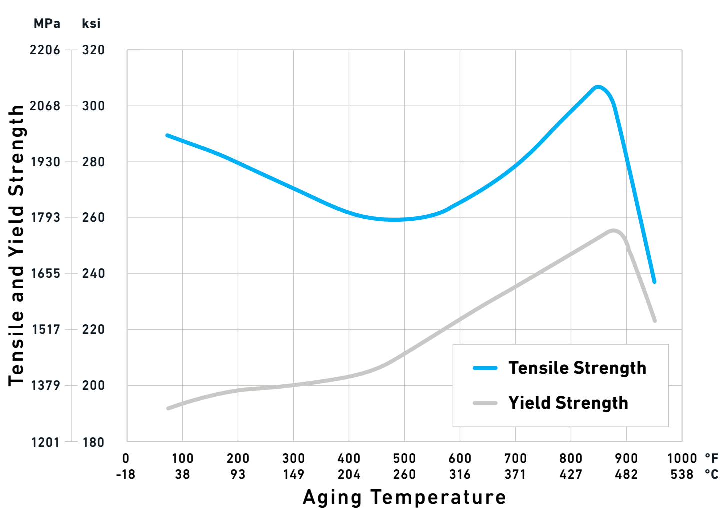
EFFECT OF AGING TEMPERATURE ON REDUCTION OF AREA AND ELONGATION

Longitudinal orientation: Heat treated 1625°F (885°C) 1 hour, air cooled, refrigerated -100°F (-73°C) 1 hour, air warmed, aged 5 hours, air cooled.



EFFECT OF AGING TEMPERATURE ON TENSILE AND YIELD STRENGTHS

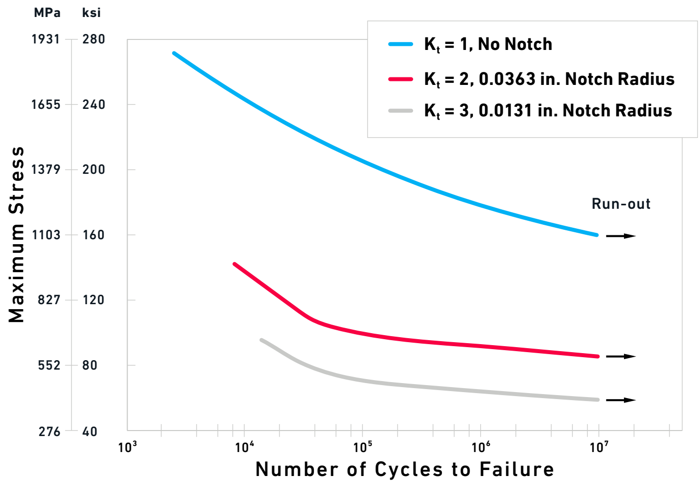
Longitudinal orientation: Heat treated 1625°F (885°C) 1 hour, air cooled, refrigerated -100°F (-73°C) 1 hour, air warmed, aged 5 hours, air cooled.



> AerMet 100

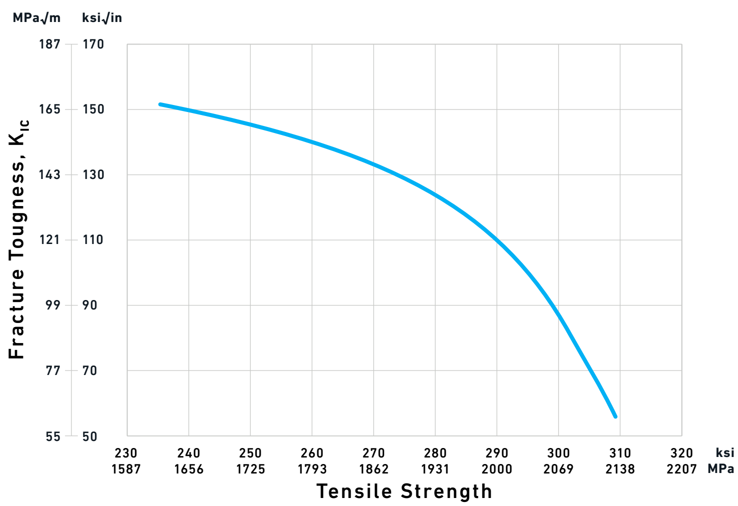
EFFECT OF SPECIMEN DESIGN ON FATIGUE RESISTANCE

K_t = 1 data are from two labs. R = 0.



FRACTURE TOUGHNESS VS. TENSILE STRENGTH

Longitudinal data. Solution treated 1625°C (885°C).

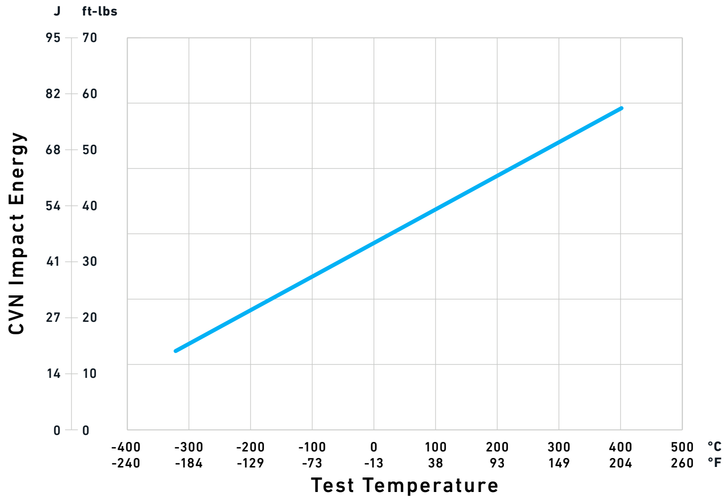


info@cartech.com | 610 208 2000

> AerMet 100

TYPICAL CHARPY V-NOTCH IMPACT ENERGY

L-R orientation. Heat treatment: 1625°F (885°C) 1 hour, vermiculite cooled, refrigerated -100°F (-73°C) 1 hour, air warmed, aged 900°F (482°C) 5 hours.



> AerMet 100

Heat treatment

Decarburization	Like other carbon bearing high-strength alloys, AerMet 100 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 100 can be normalized by heating to 1650°F (899°C) holding for 1 hour, and air cooling to room temperature. Optimum softening for machining is obtained by following the 1650°F (899°C) normalize with a 16-hour 1250°F (677°C) overage anneal.
Annealing	AerMet 100 is softened by using a 1250°F (677°C) overage anneal for 16 hours. The optimum annealed hardness of 40 HRC maximum is obtained following this anneal.
Solution treatment	The solution treatment temperature range is 1625°F +/-25°F (885°C +/-14°C) for 1 hour. The solution treatment temperature must be monitored by a thermocouple attached to the load.
Quenching	**Water quenching is not recommended.** Proper quenching practice is essential for AerMet 100. The alloy should be cooled from the solution treatment temperature to 150°F (66°C) in 1 to 2 hours to develop optimum properties. Individual sections larger than 2 in. diameter or 1 in. thick (plate) must be quenched with oil in order to obtain 150°F (66°C) in 1 to 2 hours. Individual sections up to 2 in. diameter or 1 in. thick (plate) will air cool to 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 insure that the 2-hour cool to 150° (66°C) is obtained.
Cold treatment	Following cooling to room temperature, to obtain the full toughness capability, AerMet 100 should be cooled to -100°F (-73°C) and held for 1 hour. The parts can then be air warmed.
Straightening	AerMet 100 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 standard aging treatment for AerMet 100 is 900°F +/-10°F (482°C +/-6°C) for 5 hours. Parts made from AerMet 100 should never be aged at a temperature below 875°F (468°C).

> AerMet 100

EFFECT OF AGING TEMPERATURE ON HARDNESS	
AGING TEMPERATURE	**HARDNESS (HRC)**
As hardened	51.0 / 53.0
875°F (468°C) 5 hours	54.5 / 55.5
900°F (482°C) 5 hours	53.0 / 54.0
925°F (496°C) 5 hours	51.0 / 52.5

Specimens solution treated using 1625°F (885°C) 1 hour, air cooled, refrigerated -100°F (-73°C) 1 hour.

Workability

Forging	Primary break down forging of AerMet 100 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 100 is somewhat more difficult to machine than 4340 at 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.

For additional information, please contact your nearest sales office:
info@cartech.com | 610 208 2000

The information and data presented herein are typical or average values and are not a guarantee of maximum or minimum values. Applications specifically suggested for material described herein are made solely for the purpose of illustration to enable the reader to make their own evaluation and are not intended as warranties, either express or implied, of fitness for these or other purposes. There is no representation that the recipient of this literature will receive updated editions as they become available.