

CBS-50 NiL™

Applicable specifications: 14-07, AMS 6278, B50TF211, C50TF84, CPW 492, EMS 35, FL-LA 2557.1 SX, MS-198, MSRR 6113, PWA 36140

Associated specification: UNS K91231

Type analysis

Single figures are nominal except where noted.

Iron	Balance	Molybdenum	4.25 %	Chromium	4.20 %
Nickel	3.40 %	Vanadium	1.20 %	Manganese	0.25 %
Silicon	0.20 %	Carbon	0.13 %		

Forms manufactured

Bar**Bar-Rounds****Billet**

Description

CBS-50 NiL is a carburizing bearing and gear steel designed for service temperatures up to 600°F (316°C). The chemistry is engineered such that when suitably carburized and heat treated, the case will have a microstructure of fine tempered martensite with an even distribution of fine carbides. The primary advantage of CBS-50 NiL steel over conventional through hardening M50 is the relatively high fracture toughness properties of the core. Because the alloy can be carburized, surface stresses can be controlled to provide excellent rolling contact fatigue characteristics.

This carburizing steel is used in critical aircraft engine bearings. It is double vacuum melted (VIM-VAR) for optimum cleanliness and performance characteristics. Vacuum arc remelting is employed to produce a preferred ingot structure for superior mechanical properties.

Key Properties:

- Double vacuum melted (VIM-VAR)
- Clean microstructure
- High core fracture toughness
- Excellent rolling contact fatigue

Markets:

- Aerospace
- Defense

Applications:

- Aircraft engine bearings and gears

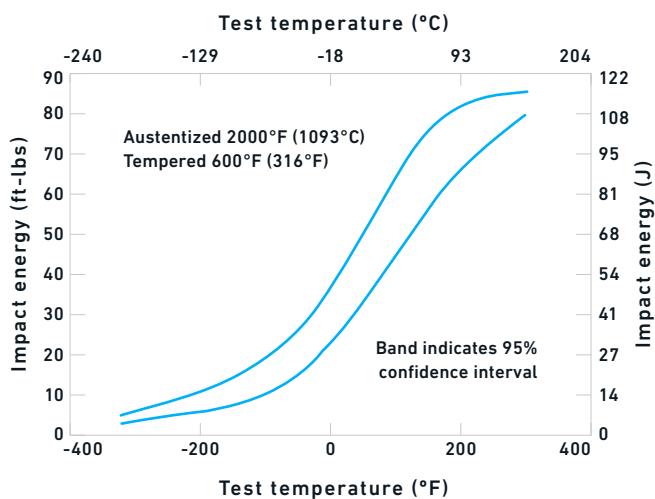
> CBS-50 NiL

Physical properties

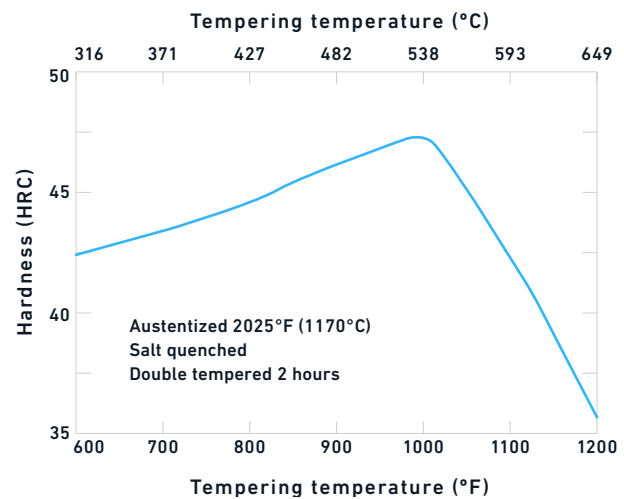
PROPERTY	At or From	English Units	Metric Units
DENSITY	—	0.284 lb/in ³	7.85 g/cm ³
ELASTIC MODULUS	—	29.5 x 10 ⁶ psi	203 GPa
CRITICAL TEMPERATURES OF CORE	AC ₁	1360°F	738°C
	AC ₃	1760°F	960°C
MARTENSITIC TRANSFORMATION TEMPERATURES OF CORE	M _s	630°F	332°C
	M _f	418°F	215°C
COEFFICIENT OF THERMAL EXPANSION	70 to 200°F (21 to 93°C)	6.10 x 10 ⁻⁶ in/in/°F	11.0 x 10 ⁻⁶ mm/mm/°C
	70 to 400°F (21 to 204°C)	6.20 x 10 ⁻⁶ in/in/°F	11.2 x 10 ⁻⁶ mm/mm/°C
	70 to 600°F (21 to 316°C)	6.44 x 10 ⁻⁶ in/in/°F	11.6 x 10 ⁻⁶ mm/mm/°C
	70 to 800°F (21 to 427°C)	6.64 x 10 ⁻⁶ in/in/°F	12.0 x 10 ⁻⁶ mm/mm/°C

Typical mechanical properties

CHARPY V-NOTCH IMPACT TRANSITION CURVE



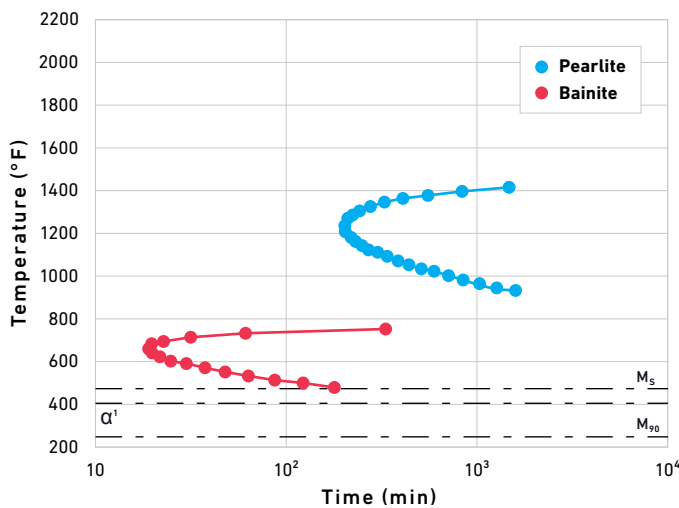
CORE TEMPERING CURVE



This transition curve was developed using mid-radius transverse (C-L orientation) specimens prepared from 3 in. diameter product. Sample blanks were austenitized at 2000°F (1093°C) and tempered five times at 600°F (316°C) for 2 hours each temper.

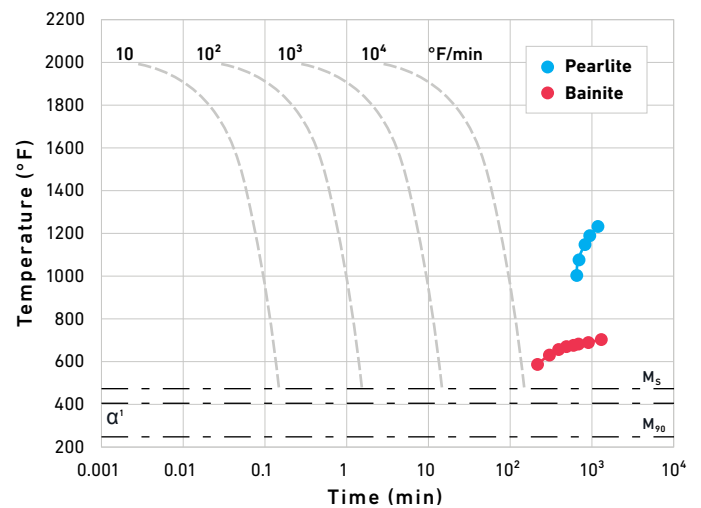
> CBS-50 NiL

TIME TEMPERATURE TRANSFORMATION



Grain size: 9 ASTM. Austenitization: 2025.0°F.

CONTINUOUS COOLING TRANSFORMATION



Grain size: 9 ASTM. Austenitization: 2025.0°F.

Fracture toughness

CBS-50 NiL is capable of generating core fracture toughness properties in excess of 40 ksi√in (43 MPa√m).

Forging

CBS-50 NiL can be readily forged or rolled into simple and contoured shapes. No unique precautions are required. The following guidelines are suggested.

Forging temperature

Forge between 1800–2000°F (982–1093°C). Do not finish below 1800°F (982°F).

Cooling

An air cool after forging may be satisfactory for most applications. However, to guard against the possibility of strain cracking, particularly for complex forgings with dissimilar cross sections, slow cool is preferred.

Heat treatment

Carburizing and subsequent heat treatment of CBS-50 NiL will produce a case microstructure similar to well-refined conventional AISI M50 bearing steel. The core is fine tempered martensite with relatively high fracture toughness. The alloy was developed under AFWAL Contract F33615-80-C-2018, and details with regard to carburizing and heat treatment are subject to United States Government restrictions. The following is offered as general guidance.

Preoxidation and carburization	For conventional atmosphere carburizing, a preoxidation treatment is recommended to produce a uniform case depth. Thermal, steam, and acid bath preoxidizing treatments are effective. When carburizing in a vacuum furnace, preoxidizing is not necessary.
Austenitize and quench	Hardening and tempering carburized CBS-50 NiL is similar to AISI M50. Preheat to 1500–1600°F (816–871°C), then raise to 2000–2050°F (1093–1121°C) and equalize. Quench immediately into salt maintained at 1050–1150°F (566–621°C) or into warm oil. Complete the quench in still air to at least 150°F (66°C).
Refrigerate	A cold treatment at -100°F (-73°C) for 2 hours will minimize the retained austenite in the case structure. If a cold treatment is going to be used, it should be performed with a minimum delay after completion of the quench.
Temper	For most applications, CBS-50 NiL is tempered between 975–1025°F (524–551°C). A double temper is preferred, and in some instances, additional tempering cycles may be desired. For each additional cycle, the material should be held at temperature for 2–4 hours.
Annealing	A subcritical anneal is satisfactory for CBS-50 NiL. Temper at 1300°F (705°C) for 2 hours per inch of thickness, then air cool to room temperature. Hardness: 255 HBW Max.

For additional information, please contact your nearest sales office:

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