

DATA SHEET



LATROBE SPECIALTY
STEEL COMPANY

Latrobe, PA 15650-0031 USA

CBS-50 NiL™ VIM-VAR

HIGH PERFORMANCE CARBURIZING BEARING AND GEAR STEEL

Typical Composition	C	Mn	Si	Cr	Ni	Mo	V
	0.13	0.25	0.20	4.20	3.40	4.25	1.20

GENERAL CHARACTERISTICS

CBS-50 NiL™ VIM-VAR 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 VIM-VAR 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 for optimum cleanliness and performance characteristics. Vacuum arc remelting is employed to produce a preferred ingot structure for superior mechanical properties.

PHYSICAL PROPERTIES

Density:

0.284 lb./in³ (7.85 g/cm³)

Modulus of Elasticity:

29.5x10⁶ psi (203 GPa)

Critical Temperatures of Core:

Ac₁: 1360°F (738°C)

Ac₃: 1760°F (960°F)

Martensitic Transformation

Temperatures of Core:

M_s: 630°F (332°C)

M_f: 418°F (215°F)

COEFFICIENT OF THERMAL EXPANSION

Temp Range °F	Temp Range °C	in / in / °F (x 10 ⁻⁶)	mm / mm / °C (x 10 ⁻⁶)
70 - 200	21 - 93	6.10	11.0
70 - 400	21 - 204	6.20	11.2
70 - 600	21 - 316	6.44	11.6
70 - 800	21 - 427	6.64	12.0

FORGING

CBS-50 NiL VIM-VAR steel 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.

SPECIFICATIONS

The following specifications are offered for general reference and should not be considered a complete listing.

AMS 6278	MSRR 6113 (Rolls Royce)
B50TF211 (GE)	CPW 492 (Pratt & Whitney)
C50TF84 (GE)	PWA 36140 (Pratt & Whitney)
MS-198 (MRC)	EMS 35 (Timken Aerospace)
14-07 (RHP/AEB)	FL-LA 2557.1 SX (FAG)

CBS-50 NiL™ VIM-VAR

CARBURIZING / HEAT TREATMENT

Carburizing and subsequent heat treatment of CBS-50 NiL VIM-VAR steel 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 VIM-VAR steel 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).

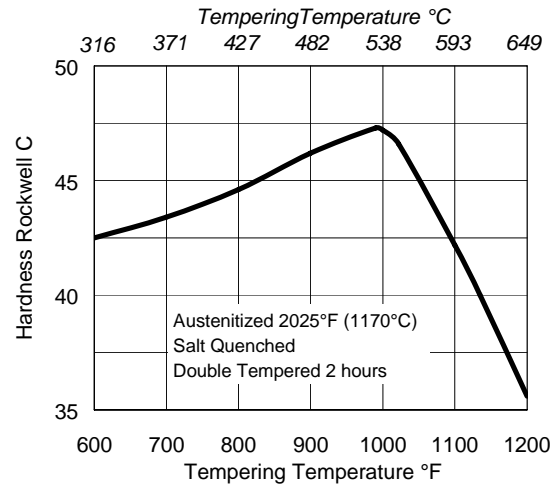
Refrigerate: A cold treatment at -100°F (-73°C) for two hours will minimize the retained austenite in the case structure. If a cold treatment is to be used it should be performed with a minimum delay after completion of the quench.

Temper: For most applications CBS-50 NiL VIM-VAR steel 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

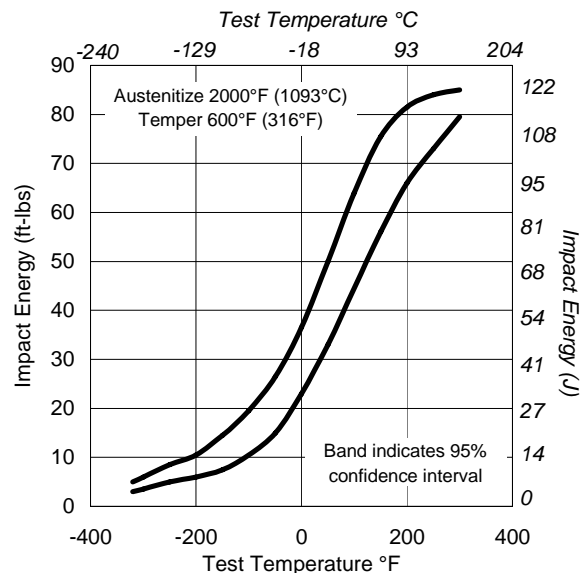
A subcritical anneal is satisfactory for CBS-50 NiL VIM-VAR steel. Temper at 1300°F (705°C) for 2 hours per inch of thickness, then air cool to room temperature. Hardness: 255 HBW Max

CORE TEMPERING CURVE



CORE MECHANICAL PROPERTIES

Charpy V-Notch impact transition curve: This transition curve was developed using mid-radius transverse (C-L orientation) specimens prepared from 3" 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.



FRACTURE TOUGHNESS

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



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