

DATA SHEET



LATROBE SPECIALTY
STEEL COMPANY

Latrobe, PA 15650-0031 USA

CBS-223™ VIM-VAR CARBURIZING BEARING AND GEAR STEEL

Typical Composition	C	Si	Mn	Cr	Mo	V	W
	0.14	0.90	0.40	5.00	1.40	0.45	1.35

GENERAL CHARACTERISTICS

CBS-223 VIM-VAR steel is a double vacuum melted carburizing steel with high hot hardness characteristics. Double vacuum melting sequentially combines vacuum induction melting with VAC-ARC™ remelting to provide for superior cleanliness, which imparts improved fatigue strength and fracture toughness to the alloy. Its high hot hardness and the improved properties readily identify CBS-223 VIM-VAR steel for use as gears, shafts and bearings in helicopter and other aerospace applications.

PHYSICAL PROPERTIES

Density: 0.280 lb/in³ (7.75 g/cm³)
annealed condition

COEFFICIENT OF THERMAL EXPANSION

Temp Range		in / in / °F	mm / mm / °C
°F	°C	(x 10 ⁻⁶)	(x 10 ⁻⁶)
70-200	21-93	6.10	10.98
70-1200	21-649	7.40	13.32
800-1200	427-649	8.10	14.58

MODULUS OF ELASTICITY

Test Temperature		Modulus	
°F	°C	10 ⁶ psi	10 ³ MPa
70	21	31.4	216.5
800	427	25.8	177.9
900	482	26.4	182.0
1000	538	25.3	174.4
1100	593	22.8	157.2

FORGING

CBS-223 VIM-VAR steel can be readily forged using conventional practices. The following guidance is offered:

Forging Temperature: 1975-2025°F
(1080-1107°C)

Finishing Temperature: 1800°F (982°C)

Cooling: The following furnace cool is recommended. Charge into a furnace equalized at 1360°F (738°C). Soak for 6 hrs. Air cool to room temperature.

CARBURIZING & HEAT TREATING

Preoxidize: Charge into furnace at 1800°F (982°C). Hold for 40-50 minutes and air cool.* A 1000-1100°F (538-593°C) steam treatment or a suitable acid etch may also be considered.

Descale: This may be necessary to remove excess oxide.

Carburize: 1650-1700°F (899-927°C). A 0.85-1.00 carbon potential is recommended.*

Quench: Furnace cool to 1500°F (816°C), maintaining atmosphere. Air cool to room temperature.

Stress Relieve: Use a subcritical cycle between 1100-1300°F (593-704°C) for 2 hours. Air cool.

Hardening: Preheat between 1400-1500°F (760-816°C) for 1 hour. Austenitize at 1850°F (1010°C) for 15-30 minutes.

Quench: Oil quench.

Refrigerate:** At -100°F (-79°C) for 2 hours, with in 4 hours.*** (within 30 minutes preferred).

Temper: Double temper at selected temperature, 2+2 hours.

* Refer to United States Patent No. 3,885,995

** Cold treatment is optional. If retained austenite must be held to an absolute minimum the cold treatment can be considered.

*** If cold treatment cannot be started within 4 hours temper parts at 600°F (316°C), then follow with a cold treatment when convenient.

CBS-223™ VIM-VAR

ANNEALING

Heat uniformly to 1650°F (899°C) and soak for 8-10 hours. Cool 25-40°F (14-22°C) per hour to 1100°F (593°C). Air cool to room temperature. Maximum annealed hardness: 207 HBW.

MICROSTRUCTURE

The case microstructure of properly carburized and heat treated CBS-223 VIM-VAR steel is fine tempered martensite with an even distribution of fine carbides. The core is also fine tempered martensite.

MICROSCOPIC CLEANLINESS

Typical Microscopic Cleanliness Requirements (J/K ASTM E45)

	A	B	C	D
Worst field, thin	1½	1½	1½	1½
Worst field, heavy	0	0	0	1.0

The above table lists the maximum worst field ratings when rated per Method D of ASTM E45. A rateable field is defined as one which has a type A, B, C or D inclusion rating of at least 1.0 thin or heavy in accordance with the Jernkontoret chart, Plate III, ASTM E45.

MACROSCOPIC CLEANLINESS

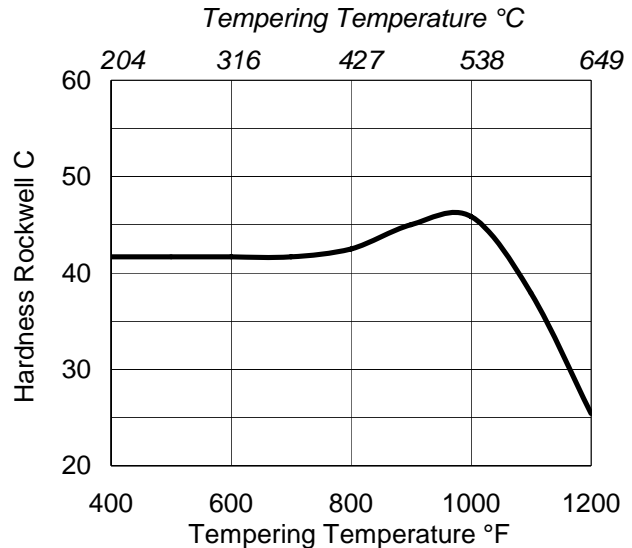
The macrostructure of CBS-223 VIM-VAR steel is equal to or better than the following macrographs of ASTM A604.

Class	Condition	Severity
1	Freckles	A
2	White Spots	A
3	Radial Segregation	B
4	Ring Pattern	B

MECHANICAL PROPERTIES

CBS-223 VIM-VAR steel heat treated from 1850°F (992°C) and tempered 2+2 hours between 900-1100°F (482-593°C) can be expected to exhibit a core ultimate tensile strength of 190-225 ksi (1310-1551 MPa). The core 0.2% yield strength would be 165-170 ksi (1138-1172 MPa).

CORE TEMPERING CURVE



Austenitized at 1850°F (1010°C) for 30 minutes. Air cooled to room temperature and tempered 2+2 hours.

SPECIFICATIONS

The popular specification for CBS-223 VIM-VAR steel is Boeing Helicopter BMS 7-223.

AVAILABLE FORMS

Billets and bars.



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Latrobe, Pennsylvania 15650-0031 U.S.A.
Phone: (724) 537-7711 Fax: (724) 532-6316
www.latrobesteel.com