Technical Datasheet

Carpenter® CTS® B90 Alloy

Type Analysis

Single figures are nominal except where noted.

Carbon	0.90 %	**Manganese**	1.00 %
Phosphorus	0.040 %	**Sulfur**	0.020 %
Silicon	1.00 %	**Chromium**	18.00 %
Molybdenum	1.10 %	**Vanadium**	0.40 %
Iron	77.54 %		

General Information

Description

Carpenter® CTS® B90 alloy is a high-carbon, chromium-molybdenum-vanadium martensitic stainless steel that provides high hardness and wear resistance. Carpenter CTS B90 alloy attains a hardness of up to HRC 57/59 when heat treated and is an excellent candidate for knives, cutting tools and bearing applications.

Applications

Carpenter CTS B90 Alloy is derived from a stainless bearing steel. The alloy offers a good combination of high hardness capability, wear resistance and corrosion resistance that has been used for cutlery, knives and a variety of other cutting tools.

Corrosion Resistance

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

Nitric Acid	Moderate	Sulfuric Acid	Restricted
Phosphoric Acid	Good	Acetic Acid	Good
Sodium Hydroxide	Moderate	Salt Spray (NaCl)	Restricted
Humidity	Excellent		

Properties

Physical Properties

Density	0.2780	lb/in³

Heat Treatment

Carpenter CTS B90 alloy, like all high-carbon steels, is subject to decarburization during thermal processing and precautions must be taken to control this condition.

Annealing

Carpenter CTS B90 alloy should be annealed in a neutral atmosphere. Heat uniformly to 1500/1600°F (816/871°C), then cool very slowly in the furnace until the furnace is black. The furnace can then be turned off and allowed to cool naturally. Fully annealed hardness is HRB 100 maximum.

Hardening

Preheat to 1400/1500°F (760/816°C) then increase temperature to 1925/1950°F (1052/1066°C), soak for 15 to 30 minutes, and quench in warm oil or cool in air. Be careful to avoid overheating the material.

Tempering

Carpenter CTS B90 alloy can be tempered over a range of temperatures from 300°F (149°C) to 800°F (427°C), soaked at least one hour then air cooled to room temperature. The specific tempering treatment chosen will depend upon a number of factors including the austenitizing temperature utilized, application of a refrigeration treatment and the desired combination of final hardness, toughness and corrosion resistance (see hardness table). To remove peak stresses yet retain peak hardness, temper at 300°F (149°C) to 350°F (177°C). Tempering at temperatures of 800°F (427°C) and higher will reduce toughness and corrosion resistance.

Sub-Zero Cooling

After hardening, the alloy may be refrigerated at -100/-120°F (-73/-84°C) for at least one hour then warmed to room temperature prior to tempering to minimize retained austenite. Refrigeration is most effective when performed within two hours after the austenitizing treatment.

Effects of Austenitizing Temperature, Cold Treatment and Tempering Treatment on Average Hardness (HRC) – Carpenter CTS B90 Alloy

0.124 in. thick (3.15 mm) Strip

(1 of 2 tables)

Austenitizing Temperature*	Sub-Zero Treatment	Tempering Treatment	Hardness (HRC)
1850F (1010C), 20 Min., AC	-	300F (149C), 2 Hrs., AC	52
	-	400F (204C), 2 Hrs., AC	52
	-	500F (260C), 2 Hrs., AC	50
	-	600F (316C), 2 Hrs., AC	50.5
	-	700F (371C), 2 Hrs., AC	50.5
	-	800F (427C), 2 Hrs., AC	51
	-100F (-73C), 1-Hr., AW	300F (149C), 2 Hrs., AC	53.5
	-100F (-73C), 1-Hr., AW	400F (204C), 2 Hrs., AC	52
	-100F (-73C), 1-Hr., AW	500F (260C), 2 Hrs., AC	50.5
	-100F (-73C), 1-Hr., AW	600F (316C), 2 Hrs., AC	50.5
	-100F (-73C), 1-Hr., AW	700F (371C), 2 Hrs., AC	51
	-100F (-73C), 1-Hr., AW	800F (427C), 2 Hrs., AC	51.5
1900F (1038C), 20 Min., AC	-	300F (149C), 2 Hrs., AC	56.5
	-	400F (204C), 2 Hrs., AC	54.5
	-	500F (260C), 2 Hrs., AC	53
	-	600F (316C), 2 Hrs., AC	53.5
	-	700F (371C), 2 Hrs., AC	53.5
	-	800F (427C), 2 Hrs., AC	54
	-100F (-73C), 1-Hr., AW	300F (149C), 2 Hrs., AC	56.5
	-100F (-73C), 1-Hr., AW	400F (204C), 2 Hrs., AC	55
	-100F (-73C), 1-Hr., AW	500F (260C), 2 Hrs., AC	53.5
	-100F (-73C), 1-Hr., AW	600F (316C), 2 Hrs., AC	53.5
	-100F (-73C), 1-Hr., AW	700F (371C), 2 Hrs., AC	54
	-100F (-73C), 1-Hr., AW	800F (427C), 2 Hrs., AC	54

*Austenitizing treatments performed in fluidized bed. If utilized, application of the sub-zero treatment should be applied within 2 hours after hardening.

Effects of Austenitizing Temperature, Cold Treatment and Tempering Treatment on Average Hardness (HRC) – Carpenter CTS B90 Alloy (continued)
0.124 in. thick (3.15 mm) Strip
(2 of 2 tables)

Austenitizing Temperature*	Sub-Zero Treatment	Tempering Treatment	Hardness (HRC)
1925F (1052C), 20 Min., AC	-	300F (149C), 2 Hrs., AC	58
	-	400F (204C), 2 Hrs., AC	56.5
	-	500F (260C), 2 Hrs., AC	54
	-	600F (316C), 2 Hrs., AC	54
	-	700F (371C), 2 Hrs., AC	54.5
	-	800F (427C), 2 Hrs., AC	55
	-100F (-73C), 1-Hr., AW	300F (149C), 2 Hrs., AC	58.5
	-100F (-73C), 1-Hr., AW	400F (204C), 2 Hrs., AC	56.5
	-100F (-73C), 1-Hr., AW	500F (260C), 2 Hrs., AC	54.5
	-100F (-73C), 1-Hr., AW	600F (316C), 2 Hrs., AC	54.5
	-100F (-73C), 1-Hr., AW	700F (371C), 2 Hrs., AC	55
	-100F (-73C), 1-Hr., AW	800F (427C), 2 Hrs., AC	56
1950F (1066C), 20 Min., AC	-	300F (149C), 2 Hrs., AC	58.5
	-	400F (204C), 2 Hrs., AC	56
	-	500F (260C), 2 Hrs., AC	55
	-	600F (316C), 2 Hrs., AC	54.5
	-	700F (371C), 2 Hrs., AC	55
	-	800F (427C), 2 Hrs., AC	56
	-100F (-73C), 1-Hr., AW	300F (149C), 2 Hrs., AC	58.5
	-100F (-73C), 1-Hr., AW	400F (204C), 2 Hrs., AC	56.5
	-100F (-73C), 1-Hr., AW	500F (260C), 2 Hrs., AC	55
	-100F (-73C), 1-Hr., AW	600F (316C), 2 Hrs., AC	55
	-100F (-73C), 1-Hr., AW	700F (371C), 2 Hrs., AC	55.5
	-100F (-73C), 1-Hr., AW	800F (427C), 2 Hrs., AC	56.5

*Austenitizing treatments performed in fluidized bed. If utilized, application of the sub-zero treatment should be applied within 2 hours after hardening.

Workability

Hot Working

Carpenter CTS B90 alloy should be handled like other high-speed tool steels. Preheat to 1400/1500°F (760/816°C), then heat slowly and uniformly to 2100/2250°F (1149/1232°C). Do not forge below 1700°F (927°C), and reheat as often as necessary. Cool in a furnace heated to about 1550°F (843°C), soak uniformly at this temperature, then shut off the heat and cool slowly in the furnace. Anneal after forging. Cool to room temperature before annealing.

Machinability

For most machining operations, Carpenter CTS B90 alloy cuts best when in the annealed condition. Because of its high carbon content, it machines similarly to high-speed steels.

Other Information

Wear Resistance

The wear characteristics in the table below were generated using ASTM G65 Procedure “A”, the Standard Practice for Conducting Dry Sand/Rubber Wheel Abrasion Tests. The data are presented as volume loss as required by the ASTM Standard. It should be noted, therefore, that a lower number means better wear resistance.

ASTM G65 Dry Sand/Rubber Wheel Abrasion Test Results – Carpenter CTS B90 Alloy

Material	Heat Treatment	Hardness (HRC)	Average Volume Loss (mm^3)
CTS B90	1925F (1052C), 20 Min., AC + 400F (204C), 2 Hrs., AC	54.5	74.0
CTS B90	1925F (1052C), 20 Min., AC + -100F (-73C), 1 Hr., AW + 400F (204C), 2 Hrs., AC	54.5	72.2
CTS B90	1950F (1066C), 20 Min., AC + 300F (149C), 2 Hrs., AC	57.5	68.2
CTS B90	1950F (1066C), 20 Min., AC + -100F (-73C), 1 Hr., AW + 300F (149C), 2 Hrs., AC	57.5	66.2
Reference Grades			
440C	1900F (1038C), 25 Min., OQ + -100F (-73C), 1Hr., AW + 350F (177C), 1 Hr., AC	58.5	66.9
D2	1850F (1010C), 25 Min., AC (As Hardened)	63.5	37.6

Forms Manufactured

- Plate
- Strip

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