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Global Steel Grade Encyclopedia

涵盖的行业或国家与地区类别

ASTM INTERNATIONAL	GJB	SAE INTERNATIONAL	EU	AISI	DIN	AMS	ISO	JASO
国材料与试验协会	国家军用标准	动力机械工程师协会	前欧洲标准化	美国钢铁学会	德国工业标准	[空航天材料规范	国际标准	日本汽车标准组织
EN	JB	UNS	UNI	ASME	SS	GB	JIS	
欧洲标准	ı国机械行业标准	统一编号系统	意大利标准	美国机械工程师协会	瑞典标准	国家标准	日本工业标准	

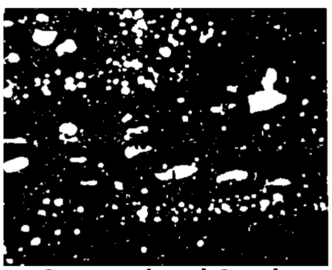
CPM S60V

DATA SHEET

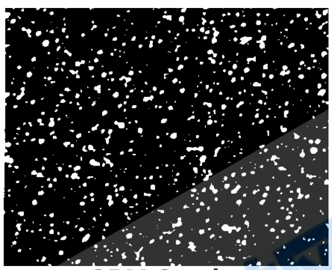
CRUCIBLE CPM® S60V®
(CPM 440V®)

Issue #4

CPM S60V is a corrosion-resistant, highly wear-resistant tool steel made by the Crucible Particle Metallurgy process. It is essentially 440C martensitic stainless steel enriched with a uniform dispersion of very fine vanadium carbides for exceptionally good wear resistance. CPM S60V offers corrosion resistance equivalent to 440C with substantial improvement in wear resistance over both 440C and D2, and other high chromium tool steels. With characteristics of both stainless steels and tool steels, S60V is ideally suited for corrosion-resistant applications requiring unusually high wear resistance, as well as for high wear applications, requiring corrosion resistance. To the custom knifemaker, CPM S60V offers a corrosion-resistant bladestock with exceptional edge-holding characteristics. Only CPM S90V surpasses S60V in both wear and corrosion properties, but, it should be noted that S60V is easier to grind due to its lower vanadium content.



Conventional Steel



CPM Steel

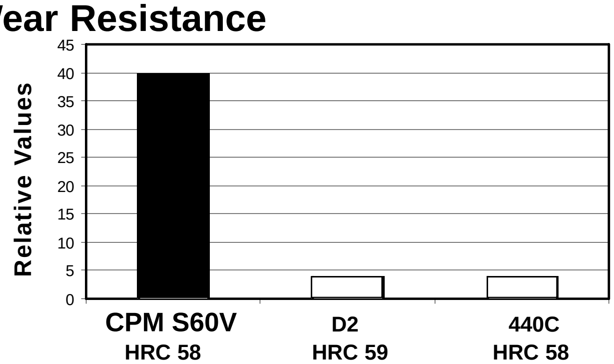
The CPM process results in a finer, more uniform carbide distribution imparting improved toughness and grindability to high alloy steels. The CPM process also allows the design of more highly alloyed grades which cannot be produced by conventional steelmaking.

Typical Applications

Long-wearing Specialty Cutlery
Industrial Knives, Slitters, and Cutters
Pelletizing Equipment
Wear Components for Food and Chemical Processing

Note: These are some *typical* applications. Your specific application should not be undertaken without independent study and evaluation for suitability.

Wear Resistance



Carbon	**2.15%**
Chromium	**17.0%**
Vanadium	**5.5%**
Molybdenum	**0.4%**

Physical Properties

Elastic Modulus	31X10⁶ psi	215 GPa
Density	0.27 lbs/in³	7.4g/cm³
Thermal Conductivity @ 200°F (65°C)		
	10 BTU/hr-ft-°F	17.3 W/m-°K

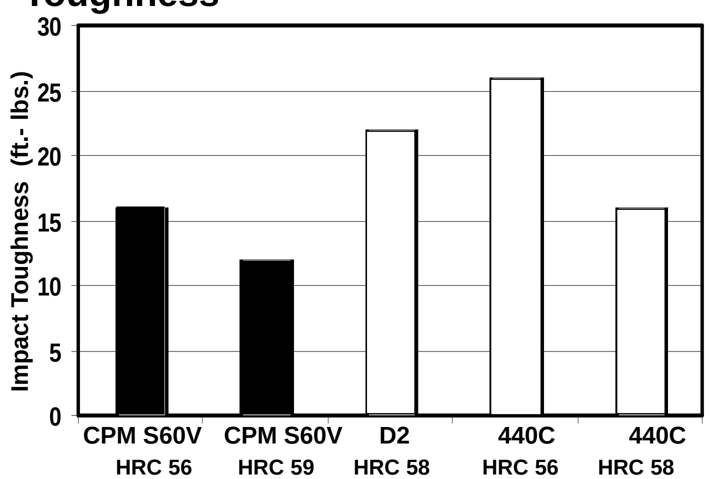
Coefficient of Thermal Expansion

°F	°C	in/in/°F	mm/mm/°C
70-400	20-200	6.1×10^{-6}	11.0×10^{-6}
70-600	20-315	6.4×10^{-6}	11.5×10^{-6}
70-1100	20-593	6.8×10^{-6}	12.2×10^{-6}

Mechanical Properties

	HARDNESS(1)		IMPACT TOUGHNESS(2)	
	HRC	Heat Treatment	ft.-lb	(Joules)
CPM S60V	56	(A)	16	(22)
"	59	(B)	12	(16)
"	60.5	(C)	11	(15)
440C	56	(D)	26	(35)
"	58	(E)	16	(22)
D2	59	(F)	21	(29)

Toughness



(1) A=Hardened 1850° F (1010° C), double tempered 400°F (205C)
B=Hardened 1950° F (1065° C), double tempered 400°F (205°C)
C=Hardened 2050° F (1120° C), double tempered 400°F (205° C)
D=Hardened 1900° F (1040°C), double tempered 600° F (315° C)
E=Hardened 1900° F (1040°C), double tempered 400° F (205° C)
F=Hardened 1850° F (1010°C), double tempered 600° F (315° C)
(2) Charpy C-notch impact test

Crucible...
The Tool Steel Pros®

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Corrosion Resistance

The corrosion resistance of CPM S60V is generally comparable to that of 440C. High temperature oxidation resistance is somewhat lower than 440C.

Special Notes to Knifemakers:

Hardness: For bladestock, the recommended hardness is HRC 56/58, which is designed to provide an excellent combination of corrosion resistance wear resistance and edge toughness. Because of its high alloy content, CPM S60V will outperform higher hardness conventional grades of bladestock.

Heat Treatment: Proper heat treatment is critical to achieve optimum edge holding ability and good toughness. CPM S60V requires higher hardening temperatures than common knife grades and care must be taken to protect the blade's surface from oxidation during heat treatment. This requires the use of a furnace with atmosphere controls, or simply wrapping the blade with stainless foil wrap. CPM S60V is air hardening, like most high alloy tool steels, but a good fast air cool is recommended to achieve proper hardness. If the blade is wrapped in foil, the foil should be removed immediately following the high heat to avoid any insulating effect. Proper tempering is also highly important. Two draws are recommended at a high enough temperature and for sufficient time to relieve stress without degrading corrosion resistance or hardness.

Recommended Bladestock Heat Treatment:
Austenitize: 2050°F (1120°C), fast air cool.
Temper: Double temper at 500°F (260°C) 2 hrs. each, air cooling to room temperature between tempers.

Machinability and Grindability

Due to its high vanadium carbide content, the machinability and grindability of S60V will be slightly more difficult than that of D2 or 440C. Similar grinding equipment and practices are acceptable. SG type alumina wheels or CBN wheels have generally given the best performance with the CPM steels.

Tempering Temp. °F (°C)	Heat Treat Response (HRC)					
	Air Cooled			Salt/Oil Quenched		
	1850 (1010)	1950 (1065)	2050 (1120)	1850 (1010)	1950 (1065)	2050 (1120)
As Quenched	54	58	60	56	60	62
400 (205)	52	56	58	54	58	60
500 (260)	52	54	57	53	55	59
600 (315)	51	54	56	52	55	58
700 (370)	51	54	56	52	55	58

Thermal Treatments

Critical Temperature: 1580°F (860°C)

Annealing

Heat to 1650°F (900°C), hold 2 hours, slow cool at a maximum rate of 25°F (15°C) per hour to 1100°F (595°C), then furnace cool or cool in still air to room temperature
Annealed Hardness: Approx. BHN 255/277

Stress Relieving

Annealed Parts: Heat to 1100-1300°F (595-705°C), hold 2 hours, then furnace cool or cool in still air.
Hardened Parts: Heat to 25-50°F (15-30°C) below original tempering temperature, hold 2 hrs., then furnace cool or cool in still air.

Hardening

Austenitize: 1850-2050°F (1010-1120°C)
Hold time at temperature: 10-30 minutes depending on section size and austenitizing temperature. Lower temperatures require longer soak times. Lower austenitizing temperatures impart greater toughness, higher austenitizing temperatures impart higher wear resistance.
Quench: Salt quench, interrupted oil quench, positive pressure gas quench or air cool at a minimum cooling rate of 150°F/min (80°C/min) to below 1000°F (540°C). Cool to below 125° F (50° C) before tempering. For optimum vacuum heat treatment response, a minimum 4 bar gas quench is recommended.
Temper: Immediately after tools have cooled to below 125° F (50°C) Double temper at 400-750°F (200-400°C). Hold for a miniumum of 2 hrs. each temper. But tempering above 800°F (425°C) may result in some loss of corrosion resistance.
A freezing treatment may be employed between the first and second tempers, if desired. Freezing treatments should always be followed by at least one temper.

PLEASE NOTE: Tempering between about 800 and 1000°F (425 and 540°C) is not recommended. All martensitic stainless steels suffer from embrittlement when tempered in this range.

Aim Hardness: HRC 56/58

Size Change: +0.02% to +0.05%
Size change shown is for a *fully martensitic microstructure*.
The presence of retained austenite may reduce the net growth. When tempering at 400-750°F (200-400°C), freezing treatments may be necessary to minimize retained austenite.

Note: Properties shown throughout this data sheet are typical values. Normal variations in chemistry, size and heat treat conditions may cause deviations from these values. For additional data or metallurgical engineering assistance, consult your local Crucible Service Center.

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