Black Wolf Knives

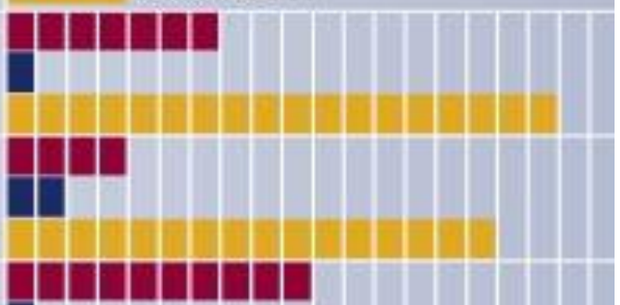
SELECTION OF COLD WORK TOOL STEELS

COLD WORK TOOL STEELS ARE DESIGNED FOR TOOLING APPLICATIONS WHERE THE SERVICE TEMPERATURE IS UNDER ABOUT 600°F (316°C). IN SELECTING COLD WORK TOOL STEELS, THE METALLURGICAL FACTORS THAT ULTIMATELY AFFECT TOOL PERFORMANCE AND LONGEVITY MUST BE CONSIDERED. THESE INCLUDE HARDNESS AND STRENGTH, TOUGHNESS, AND WEAR RESISTANCE. HARDNESS AND STRENGTH ARE IN A COMMENSURATE RELATIONSHIP; THE HIGHER THE HARDNESS, THE HIGHER THE STRENGTH. HIGHER HARDNESS ALSO GENERALLY CORRESPONDS WITH HIGHER WEAR RESISTANCE. HOWEVER, HIGH HARDNESS AND STRENGTH TYPICALLY ALSO CORRESPOND WITH LOWER TOUGHNESS, OR IN OTHER WORDS, LESS RESISTANCE TO CRACKING FROM IMPACT OR SUDDEN SHOCK LOADING. THE SPECIFIC HARDNESS, WEAR, AND TOUGHNESS REQUIREMENTS OF THE APPLICATION DETERMINE WHICH TOOL STEEL SHOULD BE USED. FOR NEW TOOLING APPLICATIONS, THE SELECTION NORMALLY INVOLVES SOME DEGREE OF TRIAL AND ERROR TO DETERMINE WHICH TOOL STEEL PROVIDES THE BEST COMBINATION OF PROPERTIES FOR THE MOST COST EFFECTIVE TOOLING PERFORMANCE.

THE NOMINAL CHEMICAL COMPOSITIONS OF THE COMMON COLD WORK TOOL STEELS ARE PRESENTED IN WEIGHT PERCENT BELOW. RELATIVE COMPARISONS OF THE PROPERTIES OF THE STEELS ARE PRESENTED IN THE CHART ON THE REVERSE SIDE. MORE SPECIFIC INFORMATION ABOUT THE STEELS MAY BE OBTAINED FROM THE INDIVIDUAL DATA SHEETS. M2 HIGH-SPEED STEEL AND H13 HOT WORK STEEL ARE INCLUDED IN THE PROPERTY COMPARISONS BECAUSE BOTH ARE SOMETIMES USED IN COLD WORK TOOLING APPLICATIONS AND TO PROVIDE A COMMON REFERENCE FOR COMPARISONS WITH THE PROPERTIES OF THE HIGH-SPEED AND HOT WORK TOOL STEELS.

Steel Grade	C	Mn	Si	Cr	W	Mo	V	Other
O1	0.94	1.20	0.30	0.50	0.50			
O6	1.45	1.00	0.90			0.25		
L6	0.70	0.60	0.25	0.70				1.40 Ni
A2	1.00	0.75	0.30	5.00		1.00	0.25	
A8	0.55	0.30	0.95	5.00	1.25	1.25		
A9	0.55	0.35	1.05	5.15		1.55	1.00	1.50 Ni
A10	1.35	1.80	1.20	0.20		1.50		1.85 Ni
D2	1.50	0.30	0.30	12.00		0.75	0.90	
D3	2.15	0.40	0.40	12.25			0.25	
D7	2.30	0.40	0.40	12.50		1.10	4.00	
LSS ™ Vertex	1.00	0.50	1.00	8.25		2.25	0.40	
Lescowear ™	1.13	0.30	1.20	7.75	1.10	1.55	2.40	
S1	0.53	0.25	0.25	1.35	2.00		0.25	
S7	0.50	0.75	0.25	3.25		1.40		
H13	0.40	0.40	1.00	5.25		1.35	1.00	
Viscount 44	0.40	0.80	1.00	5.25		1.35	1.00	0.12 S
M2	0.85	0.28	0.30	4.15	6.15	5.00	1.85	
CPM 1V	0.55	0.40	0.50	4.00		4.25	1.00	0.50 Ni
CPM 3V	0.85	0.30	1.00	5.00		1.35	2.75	
CPM M4	1.45	0.25	0.25	4.50	5.50	5.20	3.85	
CPM 9V	1.80	0.50	0.90	5.25		1.35	9.00	
CPM 10V/A11	2.45	0.50	0.90	5.25		1.35	9.80	

Black Wolf Knives

ASTM	DESCRIPTION	MI[1]	HRC	TOUGHNESS (Unnotched Izod Results) / WEAR RESISTANCE (Pin Abrasion Test) / GRINDABILITY
O1	An oil-hardening, non-shrinking tool steel with good toughness and moderate dimensional stability in heat treatment.	90	60	
O6	An oil-hardening, graphitic tool steel with excellent non-seizing properties. The graphite particles provide self lubricity and hold applied lubricants.	125	60	
L6	An oil-hardening, general-purpose tool and die steel. The nickel content provides enhanced impact toughness.	75	57	
A2	A general-purpose, air-hardening tool and die steel.	70	60	
A8	An air-hardening steel with good toughness which can be used in cold work and some limited hot work tooling applications.	80	59	
A9	An air-hardening steel with enhanced toughness which can be used in both cold work and hot work tooling applications.	70	56	
A10	An air-hardening graphitic tool steel. More dimensionally stable during heat treatment than O6 graphitic tool steel.	90	60	
D2	A general-purpose, 12% chromium, air-hardening, wear-resistant tool steel. Good dimensional stability during heat treatment.	55	62	
D3	An air-hardening, high-carbon, 12% chromium tool steel with improved wear resistance.	50	63	
D7	An air-hardening tool steel with maximum wear resistance for an ingot-cast steel. Large, hard carbides resist wear from abrasive particles.	35	63	
Lescowear™	Two very similar air-hardening tool steels with a unique combi-nation of toughness and wear resistance.	60	60	
S1	An oil-hardening, shock-resistant tool steel designed for applications involving high impact or sudden shock loading.	75	57	
S7	An air-hardening, shock-resistant tool steel with better dimen-sional stability in heat treatment.	75	57	
H13	A 5% chromium hot work steel which is often used in cold work tooling applications which need high toughness but not high strength.	70	48	
H13S	Resulfurized (machinable) prehardened H13 which can be used for a variety of tooling and maintenance applications.	40	44	
M2	A general-purpose, high speed steel which is sometimes used in cold work applications which require high strength but not high toughness.	55	64	
CPM 1v	A powder metal tool steel with a unique combination of high toughness and high strength for both cold and hot work applications.	70	57	
CPM 3V	A powder metal tool steel with a balanced alloy composition that provides high toughness and wear resistance for many cold work applications.	55	62	
CPM M4	A powder metal tool steel with an optimal combination of high strength, toughness, and wear resistance for both cold and hot work tools.	45	63	
CPM 9V	A powder metal tool steel which provides high toughness and wear resistance at a moderate strength level.	40	53	
CPM 10V/A11	A powder metal tool steel which provides extremely high wear resistance in combination with high strength and good toughness.	40	63	

[1] *Machinability Index: Relative machinability, as a percentage, compared to machining a 1% carbon tool steel.*