

DATA SHEET

D-2

Typical Composition

C	Cr	Mo	V
1.42	11.50	0.90	0.80

D-2 is an air-hardening, high carbon, high chromium tool steel, heat treatable to HRC 60-62. It offers excellent abrasion resistance, due to a large volume of carbides in the microstructure. D-2 has been widely used for many years in cold work applications requiring very high wear resistance. It is machinable in the annealed condition and like other air-hardening tool steels, exhibits minimal distortion on hardening.

Typical Applications: Stamping or forming dies, punches and dies, forming rolls, blanking dies, thread rolling dies, coining dies, lamination dies, trim dies, industrial knives and slitters, shear blades, fine blanking tools, scrap choppers, wear parts, tire shredders, and plastic injection feed screws and tips.

Mechanical Properties

Grade	Heat Treatment Austenitizing Temperature	HRC	Impact Toughness (ft-lb)	Impact Toughness (J)	Wear Resistance Adhesive
D-2	1850°F (1010°C)	60	21	28	3-4
S-7	1750°F (955°C)	57	125	165	1
A-2	1750°F (955°C)	60	40	53	2-3
CRU-WEAR®	1950°F (1065°C)	62	30	40	5-6
CPM® 3V	1950°F (1065°C)	60	70	95	7
M-2	2050°F (1120°C)	62	20	27	8-10
M-4	2050°F (1120°C)	62	32	43	20-25
CPM® 10V	2150°F (1175°C)	63	14	19	90

Machinability

The machinability of D-2 as annealed is about 35% of W-1 tool steel.

Surface Treatments

D-2 can be given standard surface treatments such as nitriding, TiN (titanium nitride) coating or hard chrome plating if desired. When using surface treatments, harden from the high side of the austenitizing range and temper at or above the process temperature of the treatment.

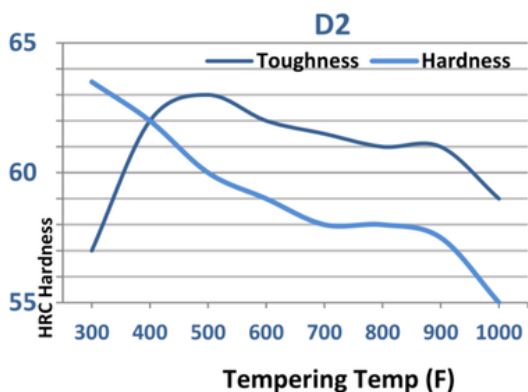
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Heat Treat Response Hardness and Impact Toughness Data			
Austenitized 1850°F (1010°C) Air Cool			
Tempering Temperature	HRC	Charpy C-Notch	
		Ft-lbs	Joules
As Quenched	63		
300°F (150°C)	62	17	23
400°F (205°C)	61	21	29
500°F (260°C)	60	23	31
600°F (315°C)	59	22	30
700°F (370°C)	58	22	30
800°F (420°C)	58	21	29
900°F (480°C)	58	21	29
1000°F (540°C)	55	19	26



Welding

Use air hardening tool steel filler material.

Annealed Material: Preheat 700–900°F (370–485°C), maintain the temperature of the work piece at 700°F (370°C) minimum during welding. Reanneal after welding or temper at 1425°F (775°C) for 6 hours.

Hardened Material: Preheat 25–50°F (15–30°C) below original tempering temperature or 350°F (175°F) minimum. Maintain the temperature of the work piece at 350°F (175°F) minimum during welding. Cool to below 150°F (65°C) after welding. Temper 25°F (15°C) below original tempering temperature or 350°F (175°C) minimum.

Thermal Treatments

Annealing: Heat to 1600°F (870°C), hold 2 hours, slow cool 25°F (15°C) per hour to 1000°F (540°C) then air cool. Or heat to 1600°F (870°C), hold 2 hours, cool to 1425°F (775°C) hold 6 hours, then air cool.

Annealed Hardness: About BHN 221/225.

Stress Relieving

Annealed Parts: Heat to 1200–1250°F (650–675°C), hold 2 hours, then cool in still air.

Hardened Parts: Heat to 25–50°F (15–25°C) below the original tempering temperature, hold 2 hours, then cool in still air.

Hardening

Preheat: Heat to 1100–1200°F (595–650°C), equalize, then to 1400–1450°F (760–790°C), equalize.

Austenitize: 1825–1875°F (995–1025°C). Hold time at temperature 30–45 minutes.

Quench: Air or positive pressure quench (2 bar minimum) to below 150°F (65°C).

Temper: 400–1000°F (205–540°C). Temper 2 hours minimum each time or at least 1 hour per inch (25mm) of thickness, double temper. Cool to room temperature in between tempers.

Cryogenic Treating: Refrigeration after the first temper may improve long term dimensions stability by transforming retained austenite. Any refrigeration treatment must be followed by a temper.

Size Change: (The amount of retained austenite has a significant effect.)

Hardening Temperature	Tempering Temperature	HRC	Longitudinal Size Change
1850°F (1010°C)	400°F (205°C)	61	+0.025%
1850°F (1010°C)	600°F (315°C)	59	-0.010%
1850°F (1010°C)	800°F (425°C)	58	-0.017%
1850°F (1010°C)	1000°F (540°C)	55	-0.006%

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