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AISI D3

High Carbon/High Chrome Tool Steel

D3 is a high carbon-high chromium steel developed for applications requiring high resistance to wear or to abrasion and for resistance to heavy pressure rather than to sudden shock. Because of these qualities and its non-deforming properties, D3 is unsurpassed for die work on long production runs. It is primarily an oil-hardening steel, and it hardens to a great depth. The production from a die after each grind is consistently uniform. While the impact strength is comparatively low, by proper adjustment of tool design and heat treatment, this steel has been used successfully for punches and dies on quite heavy material (up to 1/4 inch thick).

Among the more important applications of D3 are the following:

- Blanking, stamping, and cold forming dies and punches for long runs; lamination dies
- Bending, forming, and seaming rolls
- Cold trimmer dies or rolls
- Burnishing dies or rolls
- Plug gages
- Drawing dies for bars or wire
- Slitting cutters
- Lathe centers subject to severe wear

Typical Analysis

Carbon 2.20	Vanadium 1.00
Chromium 12.00	

Annealing

Pack annealing is preferable for D3. Heat slowly to 1600°F-1650°F and allow the charge to equalize at this temperature, then cool slowly in the furnace. In the fully annealed condition, D3 will have a Brinell hardness of 212-248.

Hardening

In general, pack hardening is recommended unless controlled atmospheric furnaces are available. Heat slowly and uniformly to 1750-1800°F. Hold 1 to 3 hours at temperature for tools of ordinary size, or until thoroughly heated through. If it is desired to heat in an open fire, preheat slowly to 1300-1400°F and raise to the hardening temperature. Quench in oil. The quenching oil should be slightly warm to the touch to insure proper fluidity.

Tempering

The usual tempering temperatures range from 300 to 500°F for tools working on medium to light gage material. Tools subject to shock, such as punches working on heavy stock, should be tempered at higher temperatures, 750 to 1000°F. It is desirable to temper in an electric furnace rather than in a molten bath or on a hot plate. The time should be approximately 1 hour at temperature for each inch of thickness. When tempering at 750- 1000°F, double tempering is recommended.

Mean Thermal Coefficient of Expansion

Temperature Range °F	Coefficients in./in./°F
70-200	6.74
70-300	6.74
70-400	6.82
70-500	6.87
70-600	6.98
70-700	6.98
70-800	7.19
70-900	7.29
70-1000	7.37
70-1100	7.43
70-1200	7.48
70-1300	7.52
70-1400	7.63

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Hardening and Tempering Series

Ground annealed bars 1 inch round by 2 inches long were preheated at 1200°F. The samples were transferred to an electric furnace with an atmosphere of about 10 percent CO, held for 30 minutes, and quenched in oil. They were then fractured and tested for hardness. Samples were tempered cumulatively for 1 hour at the indicated temperature.

The best hardening range for both open fire and pack hardening is 150-1800°F. Sections 1 inch thick and under will harden in air from 1850°F.

	Energy	
Tempering	**Absorbed**	**Hardness**
temperature - °F	**Ft-lbs.**	**Rockwell C**
As quenched	12	66.0
300	21	64.5
400	32	62.0
500	32	59.5
600	33	59.0
700	34	58.0
800	34	58.0
900	30	58.5
1000	29	55.5
1100	40	50.0
1200	53	43.0