DATA SHEET

LATROBE SPECIALTY STEEL COMPANY
Latrobe, PA 15650-0031 USA

Issue 1

LSS™ D3 Tool Steel

(ASTM D3)

Typical Composition

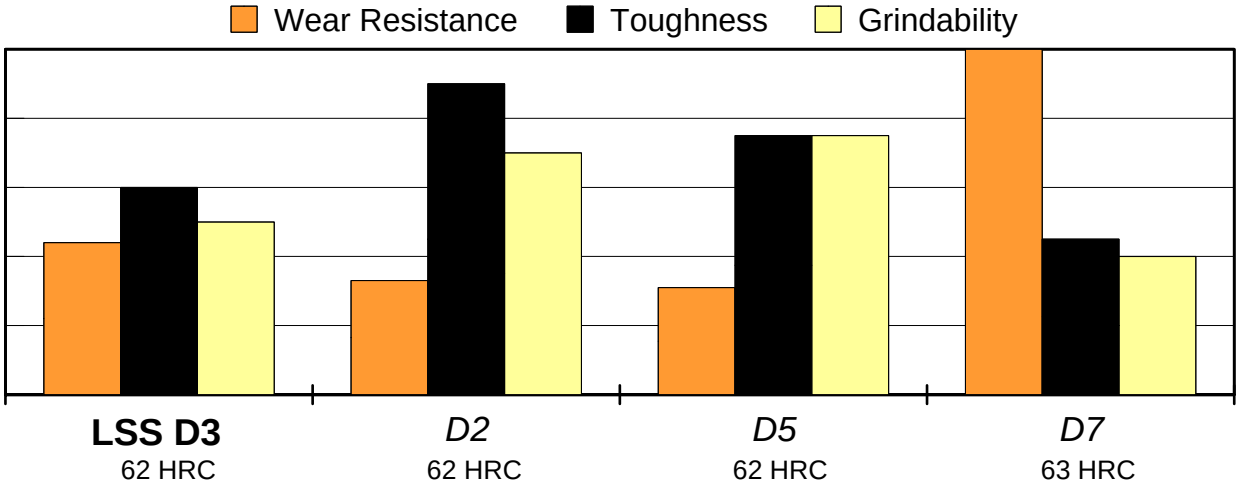
C	Mn	Si	Cr	V
2.15	0.40	0.40	12.25	0.25

LSS D3 tool steel is a high-carbon, high-chromium, oil-hardening tool steel that is characterized by a relatively high attainable hardness and numerous, large, chromium-rich alloy carbides in the microstructure. These carbides provide good resistance to wear from sliding contact with other metals and abrasive materials.

LSS D3 exhibits excellent stability in heat treatment, holding size almost as well as the air-hardening, high-carbon, high-chromium die steels such as D2.

Typical applications for LSS D3 tool steel include forming rolls, drawing dies, forming, powder compaction tooling, and lamination dies.

Relative Properties



Physical Properties

Density: 0.284 lb/in^3 (7870 kg/m^3)
Specific Gravity: 7.87
Modulus of Elasticity: 30x10^6 psi (207 GPa)

Machinability: 45-50% of a 1% carbon steel

Coefficient of Thermal Expansion: (at 61-62HRC)

Temperature, °F	in/in °Fx10^{-6}	Temperature, °C	mm/mm °Cx10^{-6}
100 - 500	6.58	38 - 260	11.84
100 - 800	7.15	38 - 427	12.87
100 - 1000	7.32	38 - 538	13.81
100 - 1200	7.54	38 - 649	13.57
100 - 1500	7.72	38 - 816	13.90

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LSS™ D3
HEAT TREATING INSTRUCTIONS

(See Tech-Topics Bulletin 102 for a more thorough explanation of heat treating.)

HARDENING:

Critical Temperatures:

Ac1: 1440°F (782°C) Ac3: 1530°F (832°C)
Ar1: 1410°F (766°C) Ar3: 1370°F (743°C)

Preheating: To minimize distortion and stresses in large or complex tools use a double preheat. Heat at a rate not exceeding 400°F per hour (222°C per hour) to 1200-1250°F (649-677°C) equalize, then heat to 1400-1450°F (760-788°C). For normal tools, use only the first temperature range as a single preheating treatment.

Austenitizing (High Heat): Heat slowly from the preheat to 1700-1750°F (927-954°C)

Quenching: Interrupted oil or pressurized gas.

For oil, quench until black, about 900°F (482°C), then cool in still air to 150-125°F (66-51°C).

For pressurized gas, the furnace should have a minimum quench pressure of 4 bars. *A quench rate of approximately 400 °F (222°C) per minute to below 1000°F (538°C) is critical to obtain the desired properties.*

Tempering: *Temper immediately after quenching*. Hold at temperature for 1 hour per inch (25.4 mm) of thickness, 2 hours minimum, then air cool to ambient temperature.

For maximum wear resistance, temper between 300-350°F (149-177°C) for a hardness of 62-63 HRC.

For the optimal balance between wear resistance and toughness, temper between 450-500°F (232-260°C). This will produce 58-60 HRC.

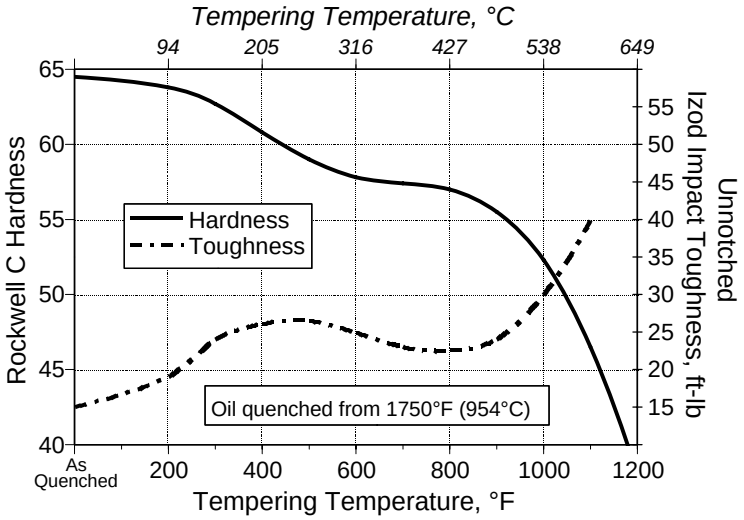
To minimize internal stresses in cross sections greater than 6 inches (152.4 mm) and to improve stability in tools that will be EDM'd after heat treatment, soaking times of 4 to 6 hours at the tempering temperature are strongly recommended.

ANNEALING: Annealing must be performed after hot working and before rehardening.

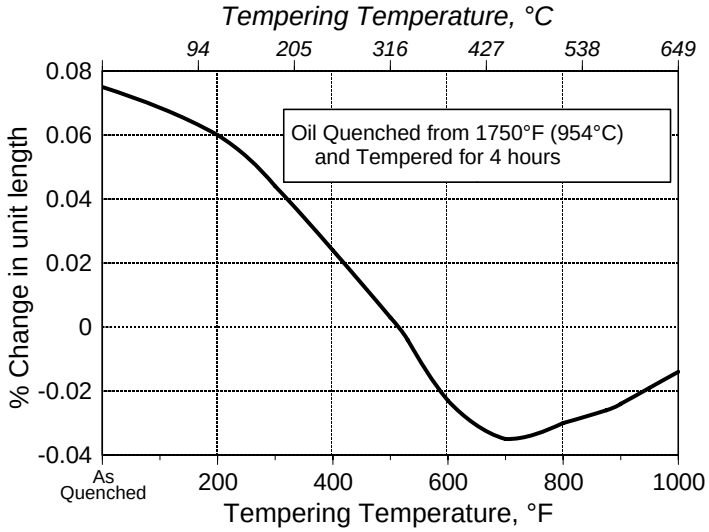
Heat at a rate not exceeding 400°F per hour (222°C per hour) to 1600-1650°F (871-899°C), and hold at temperature for 1 hour per inch (25.4mm) of maximum thickness; 2 hours minimum. Then cool slowly with the furnace at a rate not exceeding 50°F per hour (28°C per hour) to 1000°F (538°C). Continue cooling to ambient temperature in the furnace or in air. The resultant hardness should be a maximum of 255 HBW.

HEAT TREATMENT RESPONSE

As Air Cooled from	HRC
1675°F (913°C), 45 minutes	63.5
1700°F (927°C), 30 minutes	64.5
1750°F (954°C), 30 minutes	64.5
1800°F (982°C), 30 minutes	64



Size Change During Hardening



Cryogenic Treatment: Refrigeration treatments should typically be performed after the first temper, and must be followed by a second temper.

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The data presented herein are typical values, and do not warrant suitability for any specific application or use of this material. Normal variations in the chemical composition, the size of the product, and heat treatment parameters may result in different values for the various physical and mechanical properties.