DATA SHEET

Timken Latrobe Steel
A Timken Company Subsidiary
Latrobe, PA 15650-0031 U.S.A.

Issue 4

TLS™ Vertex Tool Steel

Typical Composition

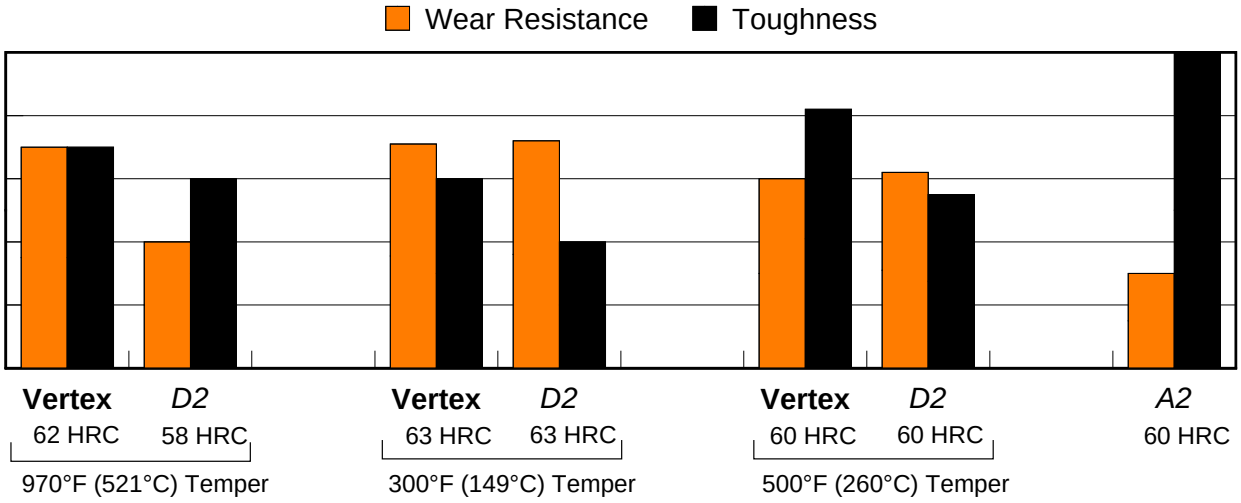
C	Mn	Si	Cr	Mo	V
1.00	0.50	1.00	8.25	2.25	0.40

TLS Vertex tool steel is a versatile, high-chromium, air-hardening tool steel that is characterized by a relatively high attainable hardness and numerous, chromium-rich alloy carbides in the microstructure. These carbides provide good resistance to wear from sliding contact with other metals and abrasive materials. The primary alloy carbides in Vertex are smaller than the large chromium-rich alloy carbides which are characteristic of D2 tool steel. These smaller carbides result in better impact toughness and superior fatigue properties compared to D2.

The molybdenum addition in Vertex enhances the hardness of the alloy carbides, and more significantly, provides superior secondary hardening response compared to D2. Therefore, unlike D2, Vertex can be tempered at higher tempering temperatures yet still attain a hardness in excess of 60 Rockwell C. Because of the higher secondary hardness, Vertex exhibits superior wear resistance compared to D2 tempered at the higher tempering temperatures, as well as the superior toughness that is the result of the high-temperature tempering.

Typical applications include thread roll dies, punches, dies for blanking, forming, and trimming, rolls, shear knives, and food processing knives.

Relative Properties



Physical Properties

Density: 0.277 lb/in^3 (7680 kg/m^3)
Specific Gravity: 7.68
Modulus of Elasticity: 30x106 psi (207 GPa)

Machinability: 65-70% 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 - 392	6.67	38 - 200	12.0
100 - 572	6.84	38 - 300	12.3
100 - 752	7.12	38 - 400	12.8
100 - 932	7.34	38 - 500	13.2
100 - 1112	7.45	38 - 600	13.4

TLS™ Vertex
HEAT TREATING INSTRUCTIONS

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

HARDENING:

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 1150-1250°F (621-677°C) equalize, then heat to 1400-1450°F (760-788°C). For normal tools, use only the second temperature range as a single preheating treatment.

Austenitizing (High Heat): Heat slowly from the preheat.

Furnace or Salt: 1850-1900°F (1010-1038°C)

For maximum wear resistance, austenitize at 1900°F (1038°C).

For maximum toughness, austenitize at 1850 (1010°C).

For the optimum combination of wear resistance and toughness, austenitize at 1885°F (1030°C).

Quenching: Air or pressurized gas.

Cool to 150-125°F (66-51°C).

Tempering: *Temper immediately after quenching*.

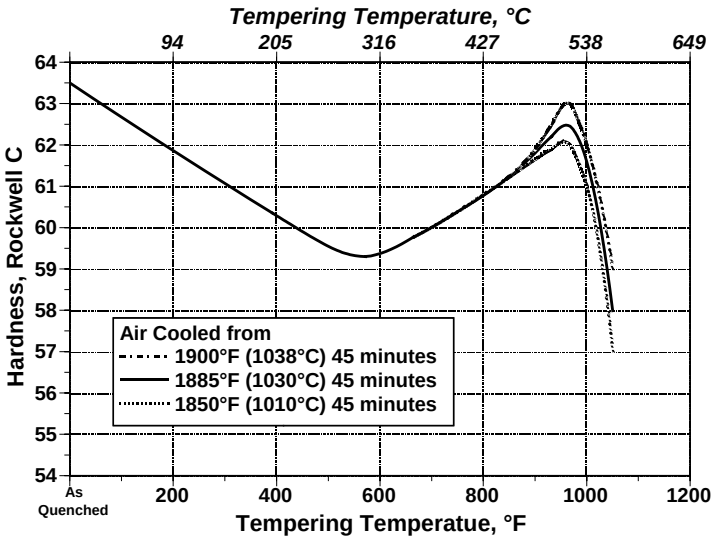
To take advantage of the secondary hardening characteristics of TLS Vertex, tempering temperatures of 970°F (521°C) and above are recommended. When using these tempering temperatures, double tempering is required. Hold at temperature for 1 hour per inch (25.4 mm) of thickness, 2 hours minimum, then air cool to ambient temperature and repeat.

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

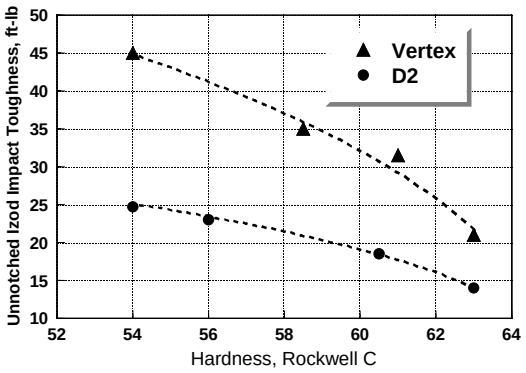
Heat at a rate not exceeding 400°F per hour (222°C per hour) to 1600-1650°F (871-899°C), and hold at temperature for 1 hour per inch (25.4mm) of maximum thickness; 2 hours minimum. Then cool slowly with the furnace at a rate not exceeding 50°F per hour (28°C per hour) to 1000°F (538°C). Continue cooling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

HEAT TREATMENT RESPONSE

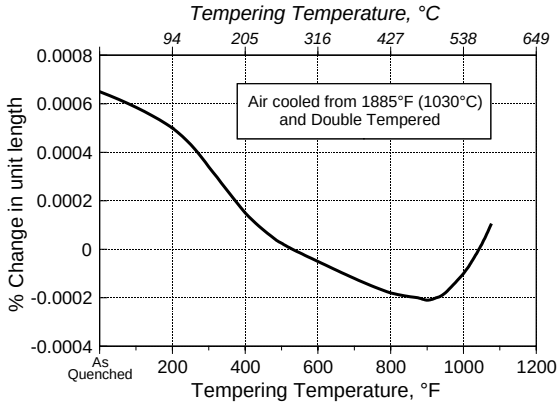
As Air Cooled from	HRC
1850°F (1010°C), 45 minutes	64.5
1885°F (1030°C), 45 minutes	64.5
1900°F (1038°C), 45 minutes	64
1925°F (1052°C), 45 minutes	63.5



Impact Toughness



Size Change During Hardening



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