NESSteel Inc.

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L-6 Die Steel
Xtra Tough Tool/Die Steel

L-6, as oil-hardening steel, is used primarily for tools, dies and machine parts that need a combination of toughness, hardness and wear resistance. Unlike other oil-hardening types, L-6 contains more nickel which provides greater toughness while retaining good hardness and wear resistance characteristics.

Typical chemical analysis of L-6:

Carbon	Managanese	Chromium	Molybdenum	Nickel
.65/.75%	.25/.80%	.60/1.20%	Max .50%	1.25/2%

L-6 is used in applications requiring high compressive strength, shock and impact resistance. Typical applications are:

- Punches
- Cams
- Bushings
- Gauges
- Shear Blades
- Spindles
- Straightening Rolls
- Forming Rolls
- Trimming Dies
- Guide Pins
- Chisel Bushings
- Spring Collets
- Master Hobs
- Coining Dies
- Dies
- Clutches
- Ball Races
- Swaging Rolls
- Ratchets
- Gears
- Power Drive Bits
- Forming Dies
- Blanking Dies
- Expanding Mandrels
- Pipe Cutter Wheels
- Plastic Molds
- Embossing Dies
- Broach Bodies

Heat Treatment

Forging

- Heat slowly to 2000˚F until piece is thoroughly heated through.
- DO NOT hot work below 1700˚F.
- To normalize: After finish forging, heat to 1600˚/1700˚F and cool in air.

Annealing

- Pack in suitable container in inert material or controlled atmosphere furnace.
- Heat slowly to 1400˚/1440˚F and hold one hour per inch of thickness.
- Allow to cool slowly at a rate not to exceed 20˚F/hour to 900˚F.
- Air cool to room temperature.
- Annealed hardness will range from 200-230 Brinell.

Stress Relieving

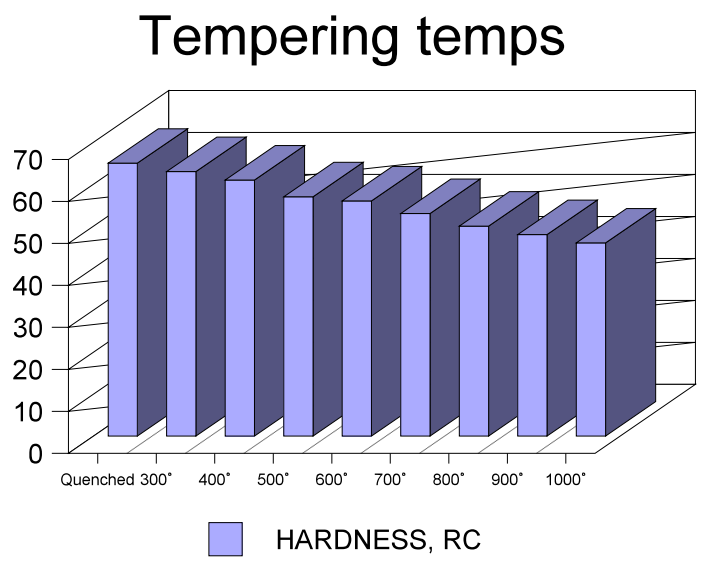
- Rough machine piece first.
- Heat piece to 1275˚F.
- Soak for 2 hours after reaching temperature.
- Cool in furnace to 900˚F, then in air to room temperature.

Hardening

- To avoid excessive scale and decarburization during hardening, select one of the following processes:
  - Heat in neutral salt bath
  - Pack in spent cast-iron chips/spent coke
  - Protective atmosphere or vacuum furnace
- Heat and soak piece at 1400˚F until heated through.
- Raise temperature to 1550˚F holding at 1 hour per inch of maximum thickness.
- Quench in oil heated to 120˚/150˚F.
- Temper immediately.

Tempering

- Most pieces can be tempered at 400˚F; pieces requiring extra toughness can be tempered between 450˚-800˚F (see chart).
- MARTEMPERING: To avoid cracking/distortion of intricate parts, two methods may be used.



- Remove piece from oil between 400 - 500˚F. Transfer to furnace or drawing bath at 400 - 450˚F, soak, cool at room temperature in air, draw to requirements.
- Quench in salt at 325˚F rather that oil. Agitate tool for several minutes in salt bath, let stand for five minutes. Cool in air to 150˚F. Immerse in boiling water for one hour. Draw to suit requirements.
- Air-hardening: Small, light sections of L-6 may be air-hardened in an airblast to a hardness of approximately 58-60 Rockwell.

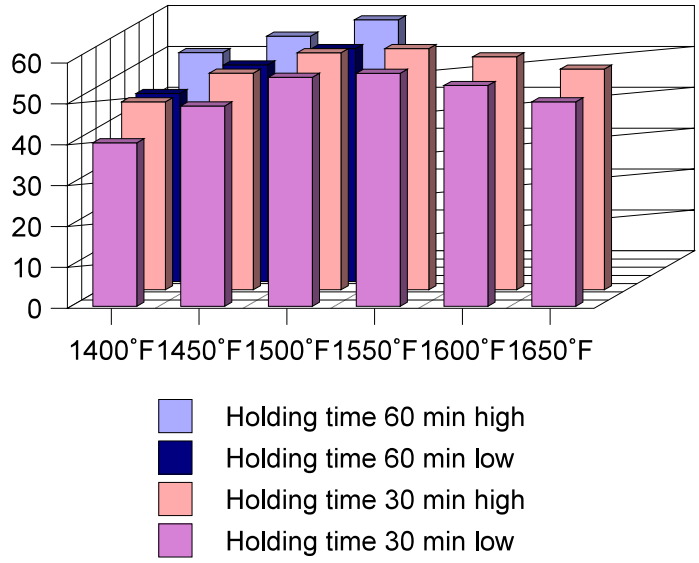
Physical Properties

Specific Gravity 7.86
Denisty, lb/in^3 ..... 0.283
Modulus of Elasticity
psi ..... 30.00 x 10^6
Mpa ..... 207 x 103

Mean Thermal Coefficient of Expansion

Range, ˚F	Coefficient x 10^{-6} in/in/˚F	Range, ˚F	Coefficient x 10^{-6} in/in/˚F
68 - 212	6.25	68 - 932	7.78
68 - 392	6.97	68 - 1112	7.97
68 - 572	7.25	68 - 1292	8.09
68 - 752	7.56		

Hardness as a Function of Austenitizing Temp.



Dimensional Changes on Hardening

Flat size: 2" x 1" x 6"
Hardened from 1550˚F in martempering bath.
Mean Dimensional Change Values:

Width	Length	Thickness
+0.08%	-0.02%	+0.05%

Round size: 4-3/4" dia x 6-1/4"
Mean Dimensional Change Values:

	Diameter	Length
Hardening in oil from 1550˚F	+0.12%	-0.02%
Hardening in air from 1550˚F	+0.05%	-0.08%