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AISI L6

Oil Hardening Tool Steel

AISI L6 is in the general class of alloy, oil-hardening tool steels. Due to its lower carbon content, it has slightly better shock-resistance than more highly alloyed types and should be used where some wear-resistance can be sacrificed for increased toughness.

Use for general purpose tools and dies where greater toughness is required, but with some sacrifice of abrasion-resistance. The following are some of the applications:

- Forming rolls
- punches
- blanking and forming dies
- trimmer dies
- clutch parts
- pawls
- knuckle pins
- clutch pins
- shear blades
- spindles

Advantages - Oil hardening, low distortion in heat-treatment, good toughness at lower hardness levels, good wear-resistance at high hardness levels.

Machinability - When annealed to a maximum of Brinell 217, L6 machines with relative ease. It has a rating of 85, as compared with a 1 pct carbon tool steel, rated at 100.

Dimensional Stability - L6 has good safe-hardening and non-deforming properties characteristic of oil-hardening steels. Tools small enough in section to be air-hardened maintain their dimensions with movement of less than 0.0001 in./in. When properly oil quenched, expansion of 0.0015 in./in.
is expected.

Typical Analysis

Carbon	0.75	Manganese	0.75
Nickel	1.75	Molybdenum	0.35
Chromium	0.90		

Annealing

To anneal L6, heat to 1400°F and hold one hour per inch of greatest thickness. Cool at 20 degrees per hour to 900 and then air-cool. A maximum hardness of Brinell 217 will be obtained following this treatment. Because of its air-hardening ability, L6 should not be normalized.

Hardening

L6 should be preheated at 1200°F, soaked, then raised to a hardening temperature of 1500 to 1550°F and held for one hour per inch of greatest cross section. Quench in oil to a temperature of 1500°F, followed immediately by tempering. Tools made of L6 in sections less than 1 in. thickness are often air-quenched from 1500°F. Air quenching provides safer hardening of intricate sections. It also results in less distortion than oil quenching.

A series of specimens 1in. round by 5 in. long were hardened in an air-blast furnace and in oil. The hardening temperatures ranged from 1400 to1800°F at intervals indicated below. The hardened samples were fractured, given fracture ratings and tested for Rockwell hardness. Following are the results obtained:

	AIR-BLAST		OIL-QUENCH	
Quenching temperature - °F	**Fracture rating**	**Rockwell C**	**Fracture rating**	**Rockwell C**
1400	9-3/4	61	9-3/4	63
1450	9-3/4	63	9-3/4	64
1500	9-1/2	63	9-3/4	64.5
1525	9-1/2	63	9-3/4	64.5
1550	8-3/4	63	9-1/4	64
1600	8-1/2	63	8-1/2	63
1650	8-1/4	63	7-1/2	63
1700	8	62.5	7-1/4	62
1750	8	62.5	7-1/4	61.5
1800	7	62	7	61

Tempering

L6 should be tempered at 400°F. However, where increased toughness is desired, at a sacrifice of some hardness, higher tempering temperatures are often used.

L6 does not become brittle, as many other die steels do, when tempered in the range of 450 to 800°F. A minimum holding time of one hour per inch of thickness should be used when tempering at 400°F.

To minimize the possibility of cracking, the steel should be tempered immediately after hardening and should be heated slowly to the desired tempering temperature.

For the tempering test of this grade, specimens 7/8 in. round by 2-1/2 in. long were hardened from 1500°F in air-blast furnace and from 1525°F in oil. The hardened specimens were tempered at temperatures ranging from 300 to 1000°F at 100-degree intervals.

Tempering – Cont.

The Rockwell C hardness results which were obtained are as follows:

Temperature - °F	Rockwell C	Rockwell C
No Draw	63	65
300	59.5	62
400	57.5	61
500	56.5	58
600	55	56
700	51	53
800	49	50
900	47.5	48
1000	43.5	46

These results may be used as a guide in tempering tools to the desired hardness. However, since specimens 7/8 in. in diameter were used in this test, it may be found that tools of heavy section or mass may be several points lower in Rockwell hardness for a given treatment.
