

TECHNICAL BULLETIN

AISI O-6 Oil Hardening Tool Steel Annealed

Typical Analysis:	Carbon	Mang.	Silicon	Moly.
	1.45	1.00	1.25	0.25

Color Code: Orange with Black Stripe

HEAT TREATMENT

Forging	2000°F max., stop at 1700°F, cool slowly
Normalizing	Do not normalize
Annealing	1425 to 1450°F, furnace cool to 1000°F hold for 1 hour/inch of greatest cross-section, air cool, Brinell 217 max
Preheating	1250°F prior to hardening
Hardening	1450 to 1500°F, oil quench to 150°F
Tempering	300 to 400°F for Rockwell C 61/62

CHARACTERISTICS

Machinability — If properly annealed to Brinell 217 max., O-6 has a machinability rating of 125, as compared with a 1% carbon tool steel, rated at 100.

Dimensional Stability — When oil quenched from the proper hardening temperature this grade normally exhibits an expansion of 0.0015 in./in. plus.

Critical Points — Critical-point ranges obtained by dilatometer test when heating and cooling at a rate of 400°F per hour are as follows:

Heating — Ac range 1400 to 1420°F
Cooling — Ar range 1340 to 1280°F

Decarburization — Decarburizes more rapidly than other tool steels when heated for forging, annealing, or hardening. This is due to its high silicon and molybdenum content. Care should therefore be used when heating O-6 to protect it from decarburization. Preheating can be very helpful, as it shortens exposure to high temperature.

INSTRUCTIONS FOR WORKING

Annealing — Heat uniformly to a temperature range of 1425 to 1450°F. Then cool slowly in the furnace to 1000°F and hold at this temperature approximately one hour per inch of greatest cross-section. Cool in air. The resulting hardness will be Brinell 217 max.

Hardening — Preheat thoroughly at approximately 1250°F and then heat to the hardening temperature of 1450 to 1500°F. For small sections, the lower part of the hardening range should be used; larger sections require the higher temperatures. All sections should be equalized at the hardening temperature for one hour per inch of greatest cross-section before quenching in oil to 150°F. Temper immediately.

Tempering — For the majority of tooling work, tempering at 300 to 400°F is satisfactory. This will result in a hardness of approximately Rockwell C 61/62. Heat the tools to the tempering temperature and hold for approximately two hours per inch of greatest cross-section.

Heat treatment, consisting of oil quenching 1-in. rd. specimens from 1475°F and tempering at various temperatures, has produced the following results.

Tempering Temperature-°F	Rockwell C
As Quenched	65
300	62
400	61
500	60
600	58
700	54



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GENERAL INSTRUCTIONS

Hardening — S-7 should be preheated at 1200°F to 1300°F and raised to the hardening temperature of 1725°F, holding at temperature for a minimum of one hour for up to 1 in. thickness and one hour for each additional inch of thickness. Sections 2 1/2 in. or less should be quenched in still air. Upon reaching 150°F, the piece should be tempered without delay.

Heat Treating Large Plastics Molds — When large plastic molds (over 6 in. in solid cross section) must be heat treated, it may not be possible to full oil quench. The potentially rapid buildup of stresses associated with liquid quenching may cause problems due to distortion or even initiate cracking in a very intricate design.

For these large mold sections, use an air quench and a 400°F temper. The high quenching stresses, resulting from the liquid quenching, will be eliminated. This procedure will usually produce a hardness in the range of ROCKWELL C 50/54. Experience has indicated that when large molds are treated to a hardness of ROCKWELL C 50/54, there is little or no difference in service life from that of molds treated to the higher hardness range of 56/58.

Tempering — S-7 is normally tempered one and one-half hours to two hours for each inch of greatest thickness. The tempering temperature varies according to the intended use. For cold working and similar applications, a tempering

temperature of 400°F and 500°F is suggested. For hot-work applications, a tempering temperature of 900°F to 1000°F is suggested. Never temper at less than 400°F.

When interrupted oil quench (to 1000°F) has been utilized in hardening, always temper immediately. Then after cooling all the way down to room temperature, temper again to insure complete transformation.

Specimens 1 in. round by 3 in. long were air-hardened

Tempering Temperature- °F	Rockwell C
As quenched	60
300	59
400	58
500	56
600	55
700	54
800	53
900	52
1000	51
1100	47

Figure 3



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