

# TECHNICAL BULLETIN

## AISI-O1 Oil Hardening Tool Steel Annealed

Typical Analysis:

Carbon  
0.90

Mang.  
1.20

Chromium  
0.50

Tungsten  
0.50

Vanadium  
0.20

Color Code: Yellow

### HEAT TREATMENT

**Forging** 1850°F to 1950°F, stop at 1500°F, cool slowly.

**Normalizing** Do not normalize

**Annealing** 1450°F, furnace-cool, Brinell 202 max

**Hardening** 1475°F, oil-quench to 150°F.

**Tempering** 300°F to 450°F, average hardness after heat treatment — Rockwell C 61/63.

### CHARACTERISTICS

**Machinability** — Annealed to Brinell 202 max, O-1 machines easily and approaches the machinability of straight-carbon water-hardening tool steel. Where a 1% carbon steel is rated at 100, O-1 has a rating of 90.

**Dimensional Stability** — When quenched from the proper hardening temperature, this grade normally expands .0015 in./in. plus. In many instances a slight scaling will occur during heat treatment which tends to counteract this expansion.

**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 1390 to 1450°F

Cooling — Ar range 1280 to 1260°F

### GENERAL INSTRUCTIONS

**Annealing** — For annealing, use controlled-atmosphere furnaces, or a quick annealing cycle to develop fair machining properties, heat slowly to 1375°F to 1425°F and cool slowly in the furnace. To develop the lowest hardness and best spheroidization for optimum machinability, heat slowly to 1450°F and furnace-cool at 20 degrees per hour to 900°F. The piece may then be removed from the furnace and cooled in air. Hardness after this cycle will be Brinell 202 max.

**Hardening** — On large parts, preheat thoroughly at approximately 1200°F, before raising to the quenching temperature of 1475 to 1500°F. Hold at the quenching

temperature for one half hour per inch of greatest cross section. Follow by quenching in oil to 150°F and temper immediately.

Quenching Temperature - °F	Fracture Grain Size	Rockwell C
1400	9	60
1425	9	62
1450	9 <sup>1/2</sup>	63
1475	9 <sup>1/2</sup>	65
1500	9 <sup>1/2</sup>	65
1525	9 <sup>1/4</sup>	65

Figure 1 1550 9<sup>1/4</sup> 65

**Tempering** — The tempering temperature generally employed may vary from 300°F to 450°F, depending on size and properties required. Small tools should be held at the tempering temperature for at least one hour, and larger tools for two hours, per inch of greatest thickness. If a second temper is used, it should be 25 degrees lower than the first.

Tempering temperatures and resulting Rockwell hardness, based on 1 in. round samples oil-quenched from 1475°F and tempered for two hours, are shown in Figure 2.

Tempering Temperature - Rockwell °F C		Tempering Temperature - Rockwell °F C	
None	65	700	53
300	63	800	50
350	62.5	900	47
400	62	1000	44
450	61	1100	39
	500	60	1200 31

Figure 2

These results on 1 in. diameter specimens may be used as a guide in tempering tools to desired hardness. However, tools of heavy section or mass may be several points lower in Rockwell hardness for a given treatment.



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