TECHNICAL BULLETIN

AISI S-5 Oil Hardening Shock Steel Annealed

Typical Analysis:	Carbon	Mang.	Silicon	Chromium	Moly.	Vanadium
	0.60	0.85	2.00	0.25	0.25	0.20

Color Code: Pink

HEAT TREATMENT

Forging	1850 to 1950°F, stop at 1650°F
Annealing	1450°F, furnace-cool, Brinell 229 max
Hardening	1600°F, oil or water quench
Tempering	400 to 650°F, Rockwell C 61/57

CHARACTERISTICS

Machinability — When annealed to Brinell 229 max, S-5 machines without great difficulty. Where a 1% carbon tool steel has a rating of 100, S-5 is given a rating of 65.

Dimensional Stability — Although S-5 is not classed as a non-deforming tool steel, it will hold size and shape reasonably well during heat treatment, if normal precautions are used in its application and treatment. Where freedom from distortion is of primary importance, the tools should always be oil quenched rather than water quenched. S-5 can be expected to expand 0.002 in./in.

Impact Properties — To determine S-5 resistance to impact, a series of tests were made with unnotched Charpy specimens 0.250 x 0.375 x 2 in. long. The specimens were rough machined oversize, heat treated and finished by grinding down to the standard size. Samples were oil quenched from 1600°F and tempered at 100-degree intervals from 300 to 1000°F. The results obtained are shown in Figure 1. Although S-5 showed impact values above 40 ft-lb without tempering, all hardened tools made of this grade should be tempered.

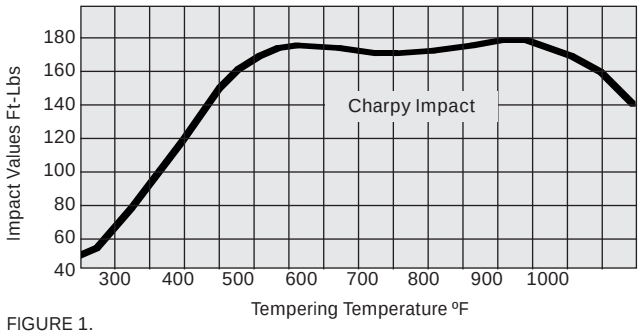

FIGURE 1.

INSTRUCTIONS FOR WORKING

Hardening — S-5 is primarily an oil hardening grade; however, it hardens satisfactorily by water quenching when the design is not too intricate. Hardening temperature for both oil and water quenching is 1600°F. Holding time at hardening heat should be just sufficient for uniformity of temperature. Holding time should not exceed a half-hour per inch of thickness because of the danger of excessive decarburization. After quenching, temper immediately.

Tempering — Normal tempering procedure for S-5 is to hold at temperature for at least two hours for each inch of greatest thickness. Tempering temperatures should be between 400 and 650°F, depending on the service desired. The resulting Rockwell C hardnesses for oil and water quenching and tempering from 300 to 1300°F by 100-degree intervals are in Figure 2.

Tempering Temperature-ºF	Rockwell C 1600º Oil-Quench	1600º Water-Quench
300	63	63
400	61	61
500	60.5	60
600	59	59
700	57.5	57.5
800	53	53.5
900	51	51
1000	49	48
1100	47	45
1200	40.5	40
1300	33.5	33

FIGURE 2.

These results may be used as a guide in tempering tools to desired hardness. However, since 3/4-in. diameter specimens were used in this test, tools of heavy section or mass may be several points lower in Rockwell hardness for a given treatment.

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