

# Heating Time to Tempering Temperature for Tool Steel

Tempering temperature is quoted as a single figure, but the time a tool needs to reach that temperature is not, and on a heavy section in a slow furnace the heat up can be longer than the hold. The two tables below are the published heating times for tool steel in a still hot air oven, in a circulating oven and in an oil bath, given as minutes per millimetre and minutes per inch of the controlling section.

**Reference only.** This is a reference summary of published practice and it is not a specification of ours. The figures belong to the specific furnace types, section shapes and surface condition named in the source, and an actual cycle depends on the furnace, the fixture and the charge. Final parameters are set by the heat treater.

## Hot air oven without circulation

| Temperature, °C | Temperature, °F | Cubes or spheres | Squares or cylinders | Average flats |
|-----------------|-----------------|------------------|----------------------|---------------|
| 120             | 250             | 1.2 (30)         | 2.2 (55)             | 3.2 (80)      |
| 150             | 300             | 1.2 (30)         | 2.0 (50)             | 3.0 (75)      |
| 175             | 350             | 1.2 (30)         | 2.0 (50)             | 2.8 (70)      |
| 205             | 400             | 1.0 (25)         | 1.8 (45)             | 2.6 (65)      |
| 260             | 500             | 1.0 (25)         | 1.6 (40)             | 2.4 (60)      |
| 315             | 600             | 1.0 (25)         | 1.6 (40)             | 2.2 (55)      |
| 370             | 700             | 0.8 (20)         | 1.4 (35)             | 2.0 (50)      |
| 425             | 800             | 0.8 (20)         | 1.2 (30)             | 1.8 (45)      |
| 480             | 900             | 0.8 (20)         | 1.2 (30)             | 1.6 (40)      |

Approximate heating time for a tool to reach the furnace temperature, for tools with dark or scaled surfaces. Source, Table 7 of Introduction to Heat Treating of Tool Steels, in ASM Handbook, Volume 4, Heat Treating.

## Circulating air oven or an oil bath

| Temperature, °C | Temperature, °F | Cubes or spheres | Squares or cylinders | Average flats |
|-----------------|-----------------|------------------|----------------------|---------------|
| 120             | 250             | 0.6 (15)         | 0.8 (20)             | 1.2 (30)      |
| 150             | 300             | 0.6 (15)         | 0.8 (20)             | 1.2 (30)      |
| 175             | 350             | 0.6 (15)         | 0.8 (20)             | 1.2 (30)      |
| 205             | 400             | 0.6 (15)         | 0.8 (20)             | 1.2 (30)      |
| 260             | 500             | 0.6 (15)         | 0.8 (20)             | 1.2 (30)      |
| 315             | 600             | 0.6 (15)         | 0.8 (20)             | 1.2 (30)      |
| 370             | 700             | 0.6 (15)         | 0.8 (20)             | 1.2 (30)      |
| 425             | 800             | 0.6 (15)         | 0.8 (20)             | 1.2 (30)      |
| 480             | 900             | 0.6 (15)         | 0.8 (20)             | 1.2 (30)      |

Approximate heating time for a tool to reach the furnace temperature, for tools with dark or scaled surfaces. Source, Table 7 of Introduction to Heat Treating of Tool Steels, in ASM Handbook, Volume 4, Heat Treating.

## How the numbers are used

The figures apply to the diameter or the thickness of the part, with the furnace maintained at the temperature in the first column. Multiply the figure by the controlling dimension of the part. For a round bar or a cylinder that is the diameter, and for a flat it is the thickness.

A worked example shows the spread. A 50 mm square block brought to 205 °C needs about 90 minutes to reach temperature in a still hot air oven, at 1.8 minutes per millimetre, and about 40 minutes in a circulating oven or an oil bath, at 0.8 minutes per millimetre. At 480 °C the same block needs about 60 minutes in the still oven and about 40 minutes in the bath.

## Bright surfaces and full charges

The times in both tables are for tools with dark or scaled surfaces. If the surface has been finish ground or is otherwise bright, twice as much time should be allowed in a still hot air oven, and no extra allowance is needed in a circulating oven or in an oil bath.

For a charge of irregular shapes or of many pieces, the published guidance is to estimate the total size of the charge and apply the same allowance to the distance from the outside to the centre of the charge rather than to any single piece.

Oil baths are usually not used above 205 °C (400 °F).

## Aobo Steel, tool steel supplier

Aobo Steel supplies tool steel to distributors and mold, tool and die shops, including D2, D3, O1, O2, A2, S7, H13, H11, H10, H21, M2, M42, L6, P20, P20+Ni and 420 and 440C stainless. Forged or hot rolled, annealed or pre-hardened, cut to your sizes, with test certificates. Source, Table 7 of Introduction to Heat Treating of Tool Steels, in ASM Handbook, Volume 4, Heat Treating.

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