

••• H-21 Hot Work Tool Steel

(AISI H-21)

H-21 is perhaps the most widely used of the Tungsten hot work steels. The 9.5% tungsten content imparts good resistance to softening at service temperatures while still maintaining adequate toughness. Unlike the higher tungsten grades, **H-21** may be cooled by continuous flow of water if the design of the die will permit.

Chemical Composition

Carbon	0.35
Manganese	0.25
Silicon	0.35
Chromium	3.50
Tungsten	9.50
Vanadium	0.50



Typical Applications

Mandrels, hot blanking dies, hot punches, drying shear blades, hot trim dies, extrusion dies, dummy blocks, piercer point, gripper dies.

Physical Properties

Critical temperature – (on heating) 1545°F

Specific Gravity – 8.26

Coefficient of Thermal Expansion

100-800°F 6.90 x 10⁻⁶ in/in/°F

100-1000°F 7.23

100-1200°F 7.34

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Forging

Heating for forging must be done slowly & uniformly. Soak through at 1900-2000°F and reheat as often as necessary, stopping work when the temperature drops below 1650 °F. After forging, cool slowly in lime, mica, dry ashes or furnace. **H-21** should always be annealed after forging.

Annealing

Heat slowly to 1600-1650 °F, hold until the entire mass is heated through, and cool slowly in the furnace (40°F per hour) to about 1000°F, after which the cooling rate may be increased. Suitable precautions must be taken to prevent excessive carburization or decarburization.

Strain Relieving

When desirable to relieve the strains of machining, heat slowly to 1050-1250°F, allow to equalize, cool in still air.

Preheat for Hardening

Warm slightly before charging into the furnace, which should be operating at 1500-1550°F.

Hardening

After thorough preheating, transfer to hardening furnace operating at 2050-2200°F, depending upon the degree of hardening required for the application, and the size of the tool, a salt bath or controlled atmosphere furnace is desirable. If these are not available, pack hardening in spent pitch coke is suggested. Long soaking times at the hardening temperature are not recommended because of the danger of grain growth.

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Quenching

Cool in air, oil or a molten salt bath operating at 1000-1100°F. In the case of oil quenching, it is usually good practice to interrupt the quench by removing the tool after it has reached about 1000°F, and allow the cooling to continue in still air. The tool should be allowed to cool to 150°F, or to where it can be held in the bare hand, and then tempered immediately.

Tempering

Tempering practice may vary with size and application, but is usually performed in the range of maximum secondary hardness or higher. Double tempering is recommended. The following chart may be used as a guide to the hardness that may be expected after tempering.

Double Tempered	Oil Quenched From 2150°F
950 °F	52.0 RC
1000 °F	53.0
1050 °F	52.3
1100 °F	51.5
1150 °F	50.0
1200 °F	45.0
1250 °F	39.0

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