H-19 Hot Work Tool Steel

(AISI H-19)

H-19 is a modification of the chromium-tungsten hot work steels containing cobalt and increased vanadium. It has good hot hardness, and excellent resistance to shock and abrasion at elevated temperatures.

Chemical Composition

Carbon	**0.40**
Chromium	**4.25**
Tungsten	**4.25**
Vanadium	**2.00**
Cobalt	**4.25**

Typical Applications

Extrusion dies, extrusion die inserts, dummy blocks, punches, forging die inserts, mandrels.

Physical Properties

Critical temperature - (on heating) 1570°F

Specific gravity - 7.96

Coefficient of Thermal Expansion

100 - 800°F	6.10 x 10^{-6} in/in/°F
100 - 1000°F	6.56
100 - 1200°F	6.83

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Forging

Heating for forging must be done slowly and 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-19** should always be annealed after forging.

Annealing

Heat slowly to 1550-1600°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 preheat furnace, which should be operating at about 1400-1500°F.

Hardening

After thorough preheating, transfer to the hardening furnace, operating at 2100-2200°F, depending upon the degree of hardening required for the application, and the size of the tool. Salt baths or controlled atmosphere furnaces are suggested to minimize surface carbon changes. Long soaking times at the hardening temperature are not recommended because of the danger of grain growth.

Quenching

Cool in air, oil, or a molten salt bath operating at 1000-1100°F. In the case of oil quenching, it is usually advisable to interrupt the quench after the part has lost color (1000-1200°F) and continue cooling in still air. Cooling should continue to 150°F, or to where parts 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 temperature range of maximum secondary hardness or higher. Double tempering is recommended, and the following chart may be used as a guide to the hardness that may be expected.

Doubled Tempered	Oil Quenched from 2175°F
800°F	57.0 RC
900°F	58.1
950°F	58.4
1000°F	58.2
1050°F	56.0
1100°F	53.2
1150°F	50.0
1200°F	46.9
1250°F	43.7
1300°F	40.0

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