

H-11 HOT WORK TOOL STEEL

H-11 is the basic 5% chromium hot work steel. The 1.5% molybdenum imparts very high hardenability to this grade, enabling it to harden throughout large sections using a still air quench. It has good resistance to softening at elevated temperatures, but its outstanding characteristic is high toughness. A slight modification of this grade has been widely used for aircraft and structural applications requiring good ductility and notch strength at high strength levels.

Advanced practices for melting, hot working, and annealing have been developed which enable **H-11** to be consistently supplied with a fine uniform annealed structure, as illustrated herein. This steel is readily heat treated to produce a uniformly fine grained microstructure. The structural uniformity results in longer die life.

TYPICAL APPLICATIONS

Die castings dies, punches, piercing tools, mandrels, extrusion tooling, forging dies.

PHYSICAL PROPERTIES

Critical temperature - (on heating) 1505°F
 Specific Gravity - 7.79
 Coefficient of Thermal Expansion
 100 - 800°F 6.68 x 10⁻⁶ in/in/°F
 100 - 1000°F 6.90
 100 - 1200°F 7.11

THERMAL PRACTICE

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-11** should always be annealed after forging.

TYPE ANALYSIS

Carbon	.35
Manganese	.40
Silicon	1.00
Chromium	5.00
Vanadium	.45
Molybdenum	1.50

ANNEALING - Heat slowly to 1550-1650°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, and then 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 - **H-11** is a steel having very high hardenability, and should be hardened by cooling in still air. The use of a salt bath or controlled atmosphere furnace is desirable to minimize decarburization, and if not available, pack hardening in spent pitch coke is suggested. The temperature employed is usually 1800-1850°F, depending on size.

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 responses shown on the following chart.

Tempered	Air Cooled From	
	1800°F	1850°F
300°F	55.5rc	55.5rc
400°F	55.5	56.0
500°F	54.0	54.5
600°F	54.0	54.0
700°F	54.5	54.5
800°F	55.0	55.5
900°F	56.5	56.5
950°F	56.0	56.5
1000°F	54.5	55.0
1050°F	52.5	53.0
1100°F	46.0	47.5
1125°F	45.5	46.0
1150°F	40.0	44.0
1175°F	38.5	39.5
1200°F	36.5	37.5

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