



NESSteel Inc

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High Toughness Steel AISI H-13

H-13 is an air- or oil-hardening tool steel noted for extreme toughness and good red-hardness. Typical analysis is shown in the chart below:

Carbon	Silicon	Manganese	Chromium	Molybdenum	Vanadium
0.37%	1.00%	0.35%	5.25%	1.30%	1.00%

H-13 is used mostly in hot tooling applications, although it is used in cold work applications where other steels tried have broken during use. Typical applications include:

- Aluminum Extrusion Dies
- Bending Dies
- Die Casting Dies
- Forging Dies
- Plastic Mold Dies
- Die Casting Inserts
- Hot Work Punches
- Extrusion Press Liners

Heat Treatment

Forging:

- Preheat slowly to 1300° F until piece is thoroughly heated through, then increase heat to 1900°F - 2050°F.
- DO NOT hot work H-13 below 1650°F.
- After forging, allow H-13 to cool slowly in insulating material or in a heated (1450°F) furnace.
- Anneal as soon as possible.

Annealing:

- Surface protection - Anneal in controlled atmosphere furnace or pack in an inert material.
- Slowly heat H-13 to 1500° - 1550°. Hold at temperature for 1½ hours per inch of maximum diameter or thickness. Cool slowly at a rate of 20° - 30° per hour to 1200°F, remove from furnace and allow to air cool. Annealed hardness is 180 - 240 Brinell.
- Stress Relieving - rough machine first, then anneal at 1150°F - 1250°F. Hold at temperature for approximately 2 hours, cool in furnace to 925°F, remove and allow to air cool.

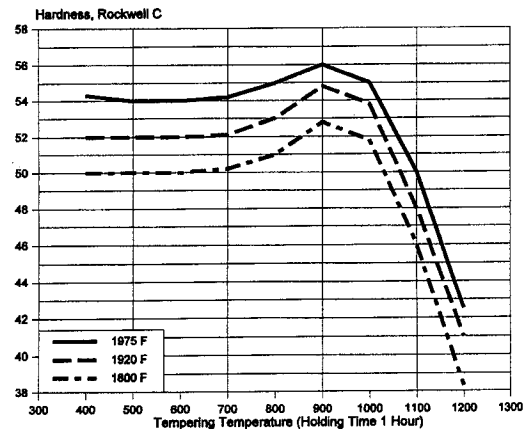
Hardening:

- Pack in inert material or use controlled atmosphere furnace to control decarburization.
- Pre-heat slowly to 1250°F - 1350°F, and hold to equalize temperature throughout the piece.
- Increase heat rapidly to 1800°F-1900°F.
- Hold steel at temperature for one hour per inch of maximum thickness. Cool in still air or oil.
- Temper immediately after the piece has cooled to 150°F.

Tempering:

- Temper immediately when piece reaches 150°F or when comfortably hand-held.
- Temper at least 50°F higher than the expected maximum operating temperature of the tool.

Tempering Graph:



Physical & Mechanical Properties (approx):

- Density, lb per cu in: .28
- Specific gravity: 7.77
- Critical points:
 - Heating (Ac) 100°/hr - begins 1580°F; ends 1640°F
 - Cooling (Ar) 50°/hr - begins 1570°F; ends 1510°F

Mean Thermal Coefficient of Expansion:

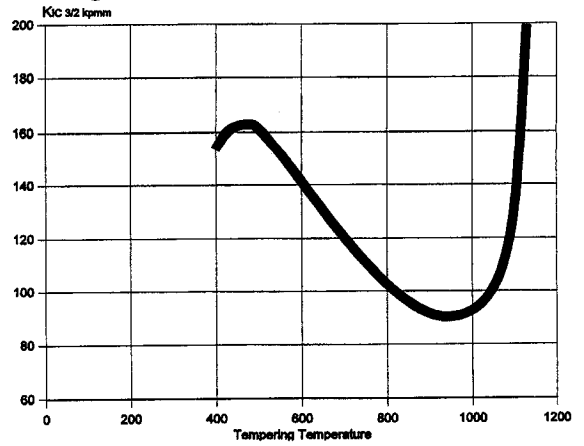
Range, °F	Coefficient $\times 10^{-6}$, in./in./°F	Range, °F	Coefficient $\times 10^{-6}$, in./in./°F
80-200	6.1	80-1450	7.5
80-400	6.4	500-1200	7.8
80-800	6.8	500-1450	8.0
80-1000	6.9	800-1200	8.1
80-1200	7.3	800-1450	8.2

Red Hardness

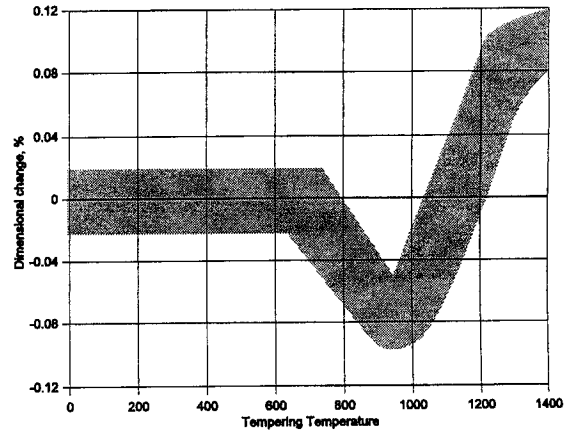
- One inch dia. x 7/8" long samples, quenched in oil from 1850°F, tempered 2 hours, held at testing temperature for 30 minutes prior to test.

Tempering Temperature, °F	Rockwell C	Testing Temperature, °F	Brinell Hardness
800	53	800	496
900	53	900	475
1000	58.5	1000	419
1100	53	1100	350
1200	51	1200	139
1300	38	1300	69

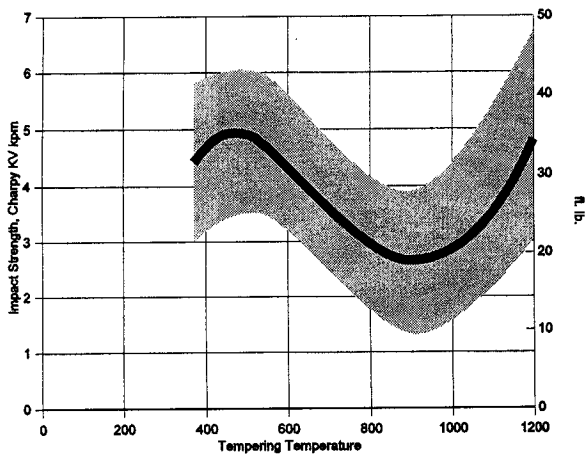
Fracture Toughness:



Dimensional Changes on Tempering:



Impact Strength (at room temp):



Time Effect at Tempering Temperature:

