NESSteel Inc

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Rehardened Mold Steel AISI P-20

AISI P-20 is a chrome-moly-nickel steel, typically supplied at 270 - 320 Brinell. Typical analysis is shown in the chart below:

Carbon	Manganese	Chromium	Molyebdenum	Nickel
0.28% - 0.40%	0.60% - 1.00%	1.40% - 2.00%	0.30 - 0.55%	1.2%

AISI P-20 is noted for its good machinability, high purity and good homogeneity, good polishing characterisitcs and good uniformity of hardness. Typical applications are

- plastic injection molds
- die-casting molds
- forming tools
- structural components

P-20 is sold in a prehardened and tempered condition, and may be used as delivered without additional heat treatment. For higher or lower hardness, please refer to Heat Treatment Section.

Heat Treatment

Forging

- Heat steel slowly to 2100°F.
- Do NOT hot work below 1700°F.
- Cool slowly in ashes or other insulating material.

Annealing

- If P-20 must be rehardened, an annealing treatment should be utilized prior to hardening.
- Heat to 1425°F, hold steel until uniformly heated through.
- Cool slowly in furnace.
- Pack anneal to protect from scaling/decarburization.

Stress Relief

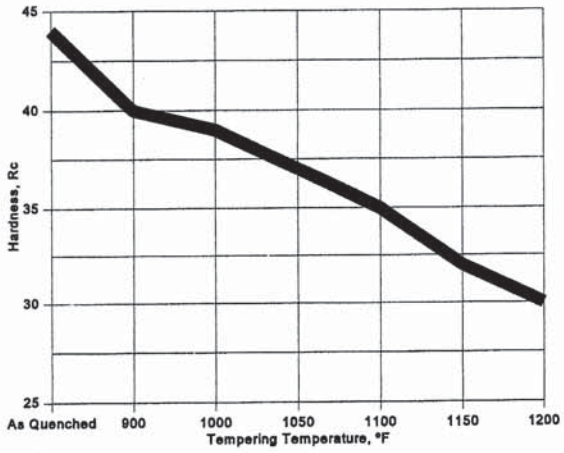
- Heat pre-hardened dies to 1075°F, hold at temperature until heated through, and air-cool.
- Heat dies in annealed condition to 1250°F, hold at temperature until heated through, and air-cool.

Hardening

- Preheat temperature: 1110°F
- Hardening temperature: 1560°F
- Holding time: 30 minnutes
- Quench in 150°F oil, or martempering bath at 575°F for maximum 4 minutes, then air-cool.
- Cooling is complete when steel has reached approximately 210°F.
- Temper immediately.

Tempering

- Protect against oxidation/decarburization by the following methods:
  - Heat in neutral salt bath
  - Pack in spent cast iron chips or paper
  - Protective atmosphere



4-inch cubes, quenched in oil from 1575°F, tempered 2 hours at indicated temperatures.

Welding

- Annealed - preheat to a minimum of 390°F.
- Hardened and tempered - preheat to previous tempering temperature or not less than 390°F.
- Do NOT preheat higher than original tempering temperature.
- After welding, allow to cool to approximately 160°F.
- Soft-annealed material should be cooled slowly to 160°F, then fully soft annealed before hardening and tempering.
- Hardened and tempered material can be air-cooled to give a hardening effect in the weld. Do NOT use compressed air; NEVER cool or quench in a liquid. Retemper hardened and tempered

tools. Do NOT exceed the original tempering temperature. This will reduce the original hardness of the steel.

- Use chromium-nickel-molybdenum alloy electrodes for welding structural steels.

Polishing

P-20 has very good polishability in the hardened and tempered condition.

Nitriding

P-20 may be nitrided for increased resistance to wear, erosion and corrosion. Surface hardness after nitriding at 975°F in ammonia gas will be about 650 HV.

Nitriding temperature, °F	Nitriding time, hours	Depth of case, approx. in.
975	20	0.012
975	30	0.014
975	60	0.020

Tuffriding

Tuffriding at 1060°F will give a surface hardness of about 700 HV. After 2 hours, the hard layer will be about 0.0004 in.

Hard-chromium plating

After plating, P-20 should be tempered for about 4 hours at 355°F to avoid hydrogen embrittlement.

Carburizing

Carburizing is recommended for applications like compression plastic molds that demand hard, abrasion resistant cases and softer, tough cores; or highly polished surface finishes for injection molds.

Tempering Data

Tempering Temperature, °F	Case Hardness, Rockwell C	Core Hardness, Rockwell C
As Quenched	62 - 64	44 - 46
600	59 - 61	42 - 45
700	56 - 58	42 - 45
800	54 - 56	41 - 44

Data was derived from 2-inch cubes, pack carburized at 1650°F for 2 hours, cooled in the pack to room temperature, hardened in an atmosphere furnace to 1550°F, and then oil quenched at 160°F. Pieces were tempered at indicated temperatures.

Mean Thermal Coefficient of Expansion

Temperature Range, °F	Coefficient x 10^{-6}, °F
70 - 100	6.7
70 - 200	6.7
70 - 300	6.9
70 - 400	7.1
70 - 500	7.2
70 - 600	7.3
70 - 700	7.5
70 - 800	7.6
70 - 900	7.7
70 - 1000	7.8
70 - 1100	8.0
70 - 1200	8.1
70 - 1300	8.2
70 - 1396	8.2