ELLWOOD SPECIALTY STEEL

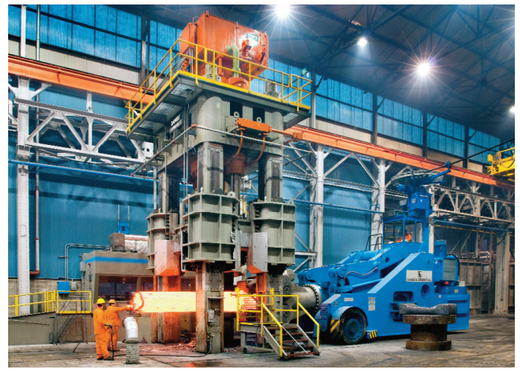
ExELL P-20m Plastic Mold Steel

CAPABILITIES

Ellwood Specialty Steel is a fully integrated producer of a wide range of specialty tool steels. Our ExELL grades are made with the advanced ASEA-SKF steel making capabilities which include an ultra high powered electric arc furnace with subsequent state of the art ladle refining and vacuum degassing equipment for the most complete and modern ladle metallurgy technology.

The end results are premium quality steels without premium pricing. This quality level rivals ESR/VAR cleanliness with extremely tight chemistry control for predictable properties and heat treat response. Supplemental ESR remelting can also be supplied.

Our steel making expertise and capability is further enhanced from a long forging history with optimum forging and heat treating practices to develop very special material characteristics of
product uniformity, cleanliness, machinability, polishability, strength, toughness, hardenability and other steel properties. All this from production facilities certified to ISO 9001.



QUALITY ASSURANCE

Ellwood Specialty Steel is committed to providing
products and services which will consistently meet or exceed all quality and performance expectations. We will provide customer and technical service that will ensure complete satisfaction

Steel will establish product programs to fully support industry or customer requirements. Our extensive stock programs are supported by very short mill lead times of custom forged products. Customized stock programs are and can be available for specific customer needs.

ELLWOOD SPECIALTY STEEL

Your tool and mold steel specialist

Made In The USA

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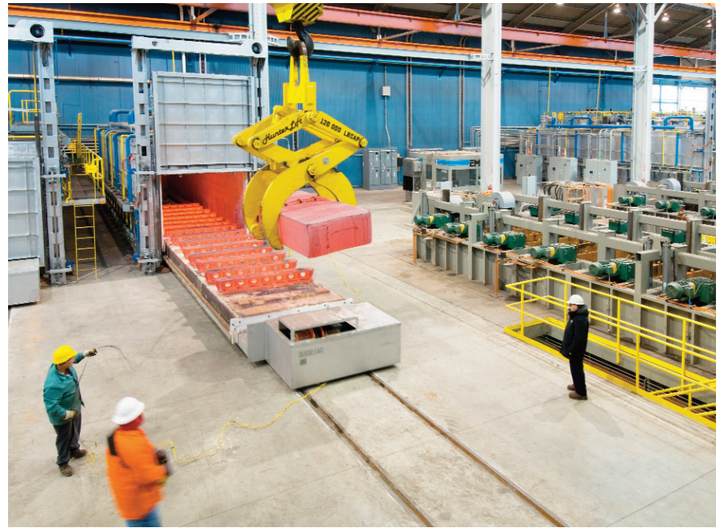

ExELL P-20m is a modified AISI P-20, premium quality Cr-Ni-Mo alloy tool steel which is normally supplied in the prehardened condition. Benefits of using ExELL P-20m include:

- No heat treat costs
- No heat treat risks or time lost
- Lowest tooling costs
- Can be surface treated (nitrided, flame hardened, plated, etc.) for any added surface performance

ExELL P-20m is used for a wide range of applications:

- Injection molds for thermoplastics
- Large compression molds
- Plastic extrusion and film dies
- Blow molds
- Zinc die cast dies
- Holders for die casting dies
- Structural or engineered components with prehardened properties

ExELL P-20m is produced to consistently high quality standards with these general characteristics:

- Good machinability
- Good polishability
- Good photoetching properties
- Uniform structure and mechanical properties
- Deep hardenability

TYPICAL ANALYSIS

C	0.35	Ni	0.80
Mn	1.50	Cr	2.00
Si	0.35	Mo	0.20

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IMPROVED MANUFACTURING AND RELATED PERFORMANCE

ExELL P-20m is manufactured to standards of special tooling quality for optimum service performance from melting through final product testing. The finished product is a material with excellent cleanliness, structure uniformity and mechanical properties.

Some specifics of manufacturing include:

- Special steel melting in advanced state-of-the-art ASEA-SKF ladle metallurgy and vacuum degassing equipment
- Very precise chemistry control
- Heavy forging reductions from ingot to finished product
- Custom and forge to shape blocks
- Supplemental machining, lifting holes
- Prehardened to 277-321 HB, other hardness levels are available
- Complete testing and quality assurance within facilities certified to ISO 9001

CHARACTERISTICS

Physical Properties

Coefficient of Thermal Expansion, in/in/F

70-400 F.....0.0000070
70-600 F.....0.00000725
70-800 F.....0.0000075

Thermal Conductivity, BTU in/ft² hr F

70 F.....202
650 F.....205
1300 F.....215

Density, lbs/cu.in.

70F.....0.2833

Modulus of Elasticity, psi

70F.....29,700,000
400F.....29,000,000

Specific Heat, Btu/lbF

70F.....0.110

HEAT TREATMENT (General Recommedations)

ExELL P-20m is normally supplied in the prehardened condition. The chemistry of ***ExELL P-20m*** is balanced to optimize heat treatment response for both hardenability and toughness to the supplied hardness level of 277-321 HB and especially for larger mold applications. However, the following thermal treat data may be useful if stress relieving, annealing or reheat treatment might be necessary

STRESS RELIEVING

In order to minimize any movement during sevice or tool making, stress relieving is normally performed between the rough and finish machine operations of tool making for prehardened material. Stress relieving is also regularly used after any welding. After rough machining, heat the part to 950F - 1000F (for prehardened material), equalize and hold 1 - 2 hours, cool in furnace to 600F and then air cool. *Note: Insure that prior tempering temperature is not attained or exceeded during stress relieving or hardness level of prehardened material will be lowered.*

ANNEALING

With a protective atmosphere or vacuum furnace, heat slowly to 1300F. Equalize and hold one hour per inch of thickness. Furnace cool 20F/hr to 1000F and equalize. Air cool to room temperature. Hardness - 250 HB max.

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HARDENING AND QUENCHING

Note: Heat treatment of machined parts involves a high risk of cracking. Minimize effects of thin and thick sections, sharp changes of section, machine marks, etc.

Preheating: Heat to 1000 - 1200F and equalize. Continue heating to hardening temperature.

Hardening: Protect against oxidation and decarburization. Austenitizing (hardening) temperature is normally 1560F. After heating to hardening temperature, equalize and hold 30 minutes at temperature.

Quenching: Oil or polymer quench.
Martempering bath 850 - 1050F,
4 minutes maximum, then air cool.

Temper as soon as quenching temperature reaches 120 - 150F.

TEMPERING

Temper immediately after quenching to about 150F. Temper two times with cooling to room temperature between tempers.

ExELL P-20m should be heated to the desired tempering temperature and held a minimum of two hours. Select the tempering temperature based on required hardness and prior quenching medium. Air cool to room temperature. Check hardness and adjust temperature for second temper. Repeat for additional temper.

Typical tempering temperature responses are:
(Use for approximate guideline only)

Tempering Temp.	Hardness (Oil Quench)
850F	410 HB
950F	388 HB
1050F	321 HB
1100F	300 HB
1200F	250 HB

SURFACE TREATMENTS

If a locally higher hardness is required, ***ExELL P-20m*** lends itself readily to flame or induction hardening to 50 - 55 HRC with air cooling. Surfaces of ***ExELL P-20m*** can also be easily chrome/nickel plated or nitrided by any standard method.

MECHANICAL PROPERTIES

Approximate tensile test properties of ExELL P-20m at a hardness of 302 HB are:

Tensile Strength (psi)	Yield Strength (psi)	%Elong	%RA
155,000	130,000	20	60

TOOL MAKING

For any additional information including welding, machining, grinding or EDM processing, please contact Ellwood Specialty Steel direct at: **800-932-2188**

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