

## 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.

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 9002.



## 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

Being a very flexible provider, Ellwood Specialty

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.

This information is intended to provide general data on our products and their uses and is based on our knowledge at the time of publication. No information should be construed as a guarantee of specific properties of the products described or suitability for a particular application. Ellwood Specialty steel reserves the right to make changes in practices which may render some information outdated or obsolete. Ellwood Specialty Steel should be consulted for current information and/or capabilities.

## ELLWOOD SPECIALTY STEEL

*Your tool and mold steel specialist*

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**ExELL H13 SUPERIOR** is the superior quality H13 hot work die steel manufactured for high demanding tooling requirements. This chromium-molybdenum-vanadium alloyed tool steel is characterized by these general properties.

- High temperature strength
- Very good toughness and ductility
- Resistance to thermal shock and fatigue
- Easy heat treatment
- Good machinability

## APPLICATIONS

**ExELL H13 SUPERIOR** is used in die casting die applications where a higher level of heat resistance along with good toughness and ductility are required

**ExELL H13 SUPERIOR** is manufactured to meet the demanding criteria of NADCA #207, Chrysler NP2080, GM DC9999-1, Ford AMTD-DC2010 and other specifications for superior H-13 quality.

**ExELL H13 SUPERIOR** is also used in most other hot work applications such as forging dies and extrusion tooling components as well as plastic molds and in critical cold or hot knife, punch or holder applications where a combination of strength and toughness are required. Typical applications and required hardness levels are:

### DIE CAST TOOLING

Part	Typical Hardness HRC
Sprue Parts	46-48
Cores	46-50
Fixed Inserts	46-50
Dies	42-48

### FORGING DIES

Work Material	Typical Hardness HRC
Aluminum	44-52
Copper Alloys	44-52
Steel	40-50

### EXTRUSION DIES

Component	Aluminum HRC	Copper HRC	Steel HRC
Dies	46-50	44-48	44-48
Liners, stems	42-50	42-48	42-48

Note :For applications generally involving aluminum,ExELL H-13 SUPERIOR is normally hardened from1870F whereas for copper alloy and steel tooling, hardening from 1900F is more common.

### TYPICAL ANALYSIS

C	0.41	Mn	0.34
Si	0.90	Cr	5.07
Mo	1.22	V	0.81





**IMPROVED MANUFACTURING AND RELATED PERFORMANCE**

ExELL H13 SUPERIOR is manufactured to standards of very high tooling quality for optimum service performance. Material is produced with excellent cleanliness, structure uniformity and mechanical properties. Manufacture includes:

- Special steel melting
- Very precise chemistry control
- Heavy forging reductions
- Special mill thermal treatment
- Complete manufacture, testing and quality assurance within facilities certified to ISO 9002

**CHARACTERISTICS**

**Coefficient of Thermal Expansion, in/in/F**

70-450 F.....0.0000070  
70-1450 F.....0.0000077

**Density, lbs/cu.in**

70 F.....180  
750 F.....185  
1450F.....195

**Thermal Conductivity, BTU in/ft<sup>2</sup> hr F**

70 F.....180  
750 F.....185  
1450F.....195

**Modulus of Elasticity, psi**

70 F.....29,400,000  
750 F.....29,500,000

**HEAT TREATMENT (General Recommendations)**

**Critical Temperatures:** Ac<sub>1</sub> - 1560 F  
Ac<sub>3</sub> - 1740 F  
MS - 570 F

**SURFACE TREATMENTS**

Surfaces of ExELL H-13 SUPERIOR can readily be chrome plated, nitrocarburized or nitrided by all commercial processes. Care must be taken to avoid hydrogen embrittlement in chrome plating. Temper at 400F for 4 hours after plating.

Avoid excessive concentrations fo nitrogen during various nitriding processes to avoid white layer and excessive network. Generally, case depths greater than 10.010” are not recommended for hot work applications.

**STRESS RELIEVING**

After rough machining of an annealed component, heat the part to 1200F, equalize and hold 1-2 hours. Furnace cool to 900F and then air cool to room temperature.

For heat treated parts, the stress relieving temperature should be at least 100-150F less than the tempering temperature used in heat treatment, so as not to lower the hardness of the part

**ANNEALING**

With a protective atmosphere or vacuum furnace, heat slowly to 1560F. Equalize and hold one hour per inch of thickness. Furnace cool 20F/hr to 1100F and equalize. Air cool to room temperature. Hardness - 229 HB maximum.



**HARDENING AND QUENCHING**

**Protect against decarburization and oxidation during austenitizing.**

**Preheating:** Heat to 1200F and equalize. Continue heating to 1550F and equalize. Complete heating to hardening temperature.

**Hardening:** Typical austenitizing range is 1850-1920F. Hardening temperature can be adjusted to develop added heat resistance. A hardening temperature of 1870F is normally used for most applications while 1900F can be used for increased heat resistance.

Hardening Temperature	Hold Time*	As-Quenched Hardness, HRC
1870F	30min	53 ± 2
1900F	15min	54 ± 2

\*Hold time = time at temperature after tool is fully heated through.

**Quenching:** Quenching should be performed as rapidly as possible without promoting excessive movement or cracking. Typical quenching media include:

- High speed gas with sufficient positive pressure in vacuum furnace
- Circulating air/atmosphere
- Martempering bath or fluidized bed at 575-1020F, then cool in air
- Warm Oil

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

**TEMPERING**

Temper immediately after quenching to about 150F. Temper a minimum of two times with intermediate cooling to room temperature.

Choose the tempering temperature to develop required hardness. ExELL H-13 SUPERIOR should be heated to the desired tempering temperature, equalized and held a minimum of two hours. Air cool to room temperature. Check hardness and adjust temperature for additional tempering operation(s). Repeat for added tempers.

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

Tempering Temperature	Hardness HRC Oil Quench	Hardness HRC Air Quench
800F	49	47
900F	47	44
1000F	43	40
1100F	40	36
1200F	36	32

**MECHANICAL PROPERTIES**

Typical tensile data vs. hardness at RT

	52 HRC	46 HRC
Tensile Strength, psi	260,000	205,000
0.2% Yeild Strength, psi	220,000	185,000
% RA	46	56
% Elongation	10	12

Typical elevated temperature tensile properties of material hardened and tempered to 46 HRC include:

Test Temp F	Yield Strength psi	Tensile Strength psi	RA %
1000	110,000	140,000	60
1100	85,000	115,000	70
1200	45,000	70,000	80
1300	20,000	30,000	90

**TOOLMAKING**

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

