



## 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 Ellwood Specialty steel reserves the right to make changes in practices which may render some information outdated or obsolete.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 -2* is an air hardening chromium-molybdenum-vanadium alloy die steel. This grade offers intermediate abrasion resistance generally between AISI O-1 and AISI D-2.

*ExELL A-2* is characterized by:

- Good wear resistance
- Good machinability
- High compressive strength
- Very good non-deforming properties
- Deep hardening
- High dimensional stability after hardening and tempering

### TYPICAL ANALYSIS

C	1.00	Cr	5.25
Mn	0.60	Mo	1.10
Si	0.25	V	0.25

## APPLICATIONS

*ExELL A-2* is well adapted for the making of intricate dies that must maintain their shape and size after hardening and tempering. *ExELL A-2* is most suitable for applications requiring a good combination of wear and toughness.

## USES

- Blanking dies
- Forming dies
- Trim Tools
- Knives
- Bending tools
- Shear blades
- Forming rolls
- Punches
- Inserts for molding





## IMPROVED MANUFACTURING AND RELATED PERFORMANCE

**ExELL A-2** is manufactured to standards of premium 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
- Full spheroidizing anneal treatment
- Complete manufacture within facilities certified to ISO 9002

## CHARACTERISTICS

### Physical Properties:

**Coefficient of Thermal Expansion, in/in/F**  
400 F.....0.0000064

**Thermal Conductivity, BTU in/ft<sup>2</sup> hr F**  
70 F.....180  
400 F.....190

**Density, lbs/cu.in.**  
70 F.....0.283

### Modulus of Elasticity, psi

70 F.....27,000,000  
400 F.....27,000,000

### Specific heat, Btu/lb F

70 F.....0.11

## HEAT TREATMENT (General Recommendations)

### ANNEALING

With a protective atmosphere or vacuum furnace, heat slowly to 1530F. Equalize and hold one hour per inch of thickness. Furnace cool 20F/hr to 1000F and equalize. Air cool to room temperature.  
Hardness - 217 HB max.

### STRESS RELIEVING

To minimize movement during heat treatment, a stress relieve can be used between the rough and finish machine operations of tool making before heat treatment.

After rough machining, heat the part(s) to 1200F, equalize and hold 1-2 hours. Furnace cool to 900F and then air cool.

## HARDENING AND QUENCHING

**Preheating :** Heat to 1200-1250F and equalize. Continue heating to hardening temperature.

**Hardening:** Protect against oxidation and decarburization. Austenitizing (hardening) temperature range is 1700-1720F but hardening is usually at 1740F.

Typical response is:

Hardening Temperature	Hold Time*	As-Quenched Hardness
1700F	40 min.	62 HRC
1740F	30 min.	63 HRC
1775F	20 min.	63 HRC

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

**Quenching:** Typical quenching media include:

- Circulating air or atmosphere
- Forced air or gas
- Step quench
- Oil

## TEMPERING

Temper immediately after quenching to about 150F. Temper at least two times with a minimum 2 hour time for each temper. Select the tempering temperature based on required hardness. Typical tempering temperature responses are:

Tempering Temperature	Hardness HRC (Austenitized 1740°F)
500F	58
975F	55
1000F	53
1025F	52



## MECHANICAL PROPERTIES

### Typical RT Tensile Strength:

Hardness	Tensile Strength, psi	Yield Strength, psi
Annealed	105,000	52,000
53HRC	255,000	200,000
50 HRC	250,000	195,000

### Typical RT Compressive Strength:

Hardness	Compressive Strength, psi	Compressive Yield Str., psi
60 HRC	415,000	310,000
55 HRC	340,000	290,000
50 HRC	290,000	240,000