

## CAPABILITIES

Ellwood Specialty Steel is a fully integrated producer of a wide range of specialty tool steels. Our ExELL grades are made with 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 result is 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 9002.

## QUALITY ASSURANCE

Ellwood Specialty Steel is committed to provide 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 integrated producer, Ellwood Specialty Steel will establish product programs to fully

support industry or customer requirements. To accommodate the plastic mold market, our extensive stock programs of ExELL P-20 and ExELL Holder (4140/50s type) is supported by very short mill lead times of custom forged blocks in these and other mold steel grades. Other customized stock programs are and can be available for specific individual 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 Ellwood Specialty Steel reserves the right to make changes in practices which may render some information outdated or obsolete.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.



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ExELL D-2 is an air hardening die steel of the high carbon, high chromium type and alloyed with molybdenum and vanadium. An abundance of very hard, wear resisting alloy carbides imparts exceptional abrasion resistance to ExELL D-2.

ExELL D-2 is characterized by:

- Very good wear resistance
- High compressive strength
- Deep hardening
- High hardness response
- High dimensional stability after hardening and tempering

## TYPICAL ANALYSIS

C	1.50	Cr	12.00
Mn	0.40	Mo	0.75
Si	0.35	V	0.80

## APPLICATIONS

ExELL A-2 is used for tools requiring very high wear resistance, combined with only moderate toughness requirements. ExELL D-2 is used in a wide variety of tooling where long runs are anticipated.

## USES

- |                        |                       |
|------------------------|-----------------------|
| ■ Blanking dies        | ■ Burnishing tools    |
| ■ Coining dies         | ■ Draw dies           |
| ■ Rolls                | ■ Forming dies        |
| ■ Trimming dies        | ■ Gages               |
| ■ Shear blades         | ■ Thread rolling dies |
| ■ Cold extrusion tools | ■ Punches             |
| ■ Lamination dies      | ■ Piercing dies       |
| ■ Lathe centers        | ■ Deep draw dies      |

## IMPROVED MANUFACTURING AND RELATED PERFORMANCE

ExEII D-2 is manufactured to standards of premium tooling quality for optimum service performance. From melting through final product testing, the finish 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 finish 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 \_\_\_\_\_ 0.0000062

**Thermal Conductivity, BTU in/ft ft hr F**  
70 F \_\_\_\_\_ 140  
400 F \_\_\_\_\_ 150

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

### Modulus of Elasticity, psi

70 F \_\_\_\_\_ 28,000,000  
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 1550F. Equalize and hold one hour per inch of thickness. Furnace cool 20F/hr to 1000F and equalize. Air cool to room temperature. Hardness - 241 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 1810 – 1920F but hardening is usually at 1850/1875F. Typical response is:

Hardening Temperature	Hold Time*	As-Quenched Hardness
1825F	60 min	62 HRC
1850F	45 min	64 HRC
1875F	30 min	65 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 Temp.	Hardness HRC (Austenitized 1860°F)
500F	60
975F	58
1000F	55
1025F	52

## MECHANICAL PROPERTIES

### Typical RT Tensile Strength:

### Typical RT Compressive Strength:

Hardness	Tensile Strength, psi	Yield Strength, psi	Hardness	Compressive Strength, psi	Compressive Yield Str., psi
Annealed	105,000	55,000	62 HRC	445,000	330,000
58 HRC	330,000	280,000	60 HRC	425,000	325,000
			55 HRC	380,000	300,000