



**EXELL H-13** | Hot Work Tool Steel



**ELLWOOD**

YOUR METALS PARTNER, FROM MELT TO DISTRIBUTION

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

- High temperature strength
- Very good toughness and ductility
- Resistance to thermal fatigue
- Ease of heat treatment
- Good machinability
- Acceptance of surface coatings

Typical applications and suggested hardness levels are:

<b>EXTRUSION DIES</b>			
Component	Aluminum HRC	Copper HRC	Steel HRC
Dies	46-50	44-48	44-48
Liners, Stems	42-50	42-48	42-48

### DIE CAST TOOLING

Part	Typical Hardness HRC
Sprue Parts	46-48
Cores	44-50
Fixed Inserts	46-50
Dies	42-48

### FORGING DIES

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

### APPLICATIONS:

**ExELL H13** is widely used in die casting die applications where a higher level of heat resistance along with good toughness and ductility are required. It is qualified to the

**NADCA 207 Specification for Die Steels** in the **Premium** and **Superior** categories as well as an Ellwood **Superior Plus** product offering higher impact test values. ExELL H13 is also qualified for major automotive and consumer product die tooling specifications.

It is also appropriate in other hot work applications such as plastic molds, forging dies, and extrusion tooling components. Additionally cold or hot knife, punch, or holder applications where a combination of strength and toughness can use this alloy. Surfaces can be polished, nitrided, or coated to enhance wear or finish properties.

### TYPICAL ANALYSIS

C	0.40	Mn	0.34
Si	0.90	Cr	5.07
Mo	1.22	V	0.81

## MANUFACTURING

**ExELL H13** is manufactured to high standards of tooling quality for optimum service and performance. The material is produced with excellent cleanliness, structure uniformity, and mechanical properties.

### Manufacturing includes:

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

## CHARACTERISTICS AND PROCESSING

### PHYSICAL PROPERTIES

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

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

#### Thermal Conductivity, BTU/ft hr F

- 70 F - 15
- 750 F - 16
- 1300 F - 16

#### Density, lbs/cu.in.

- 70 F - 0.282
- 750 F - 0.277
- 1450 F - 0.272

#### Modulus of Elasticity, psi

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

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



## CHARACTERISTICS AND PROCESSING

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

Avoid high concentrations of nitrogen during nitriding processes to minimize white layer and excessive network. Generally, case depths greater than .010" are not recommended for hot work applications.

## HARDENING AND QUENCHING

Protect against decarburization and oxidation during austenitizing.

### PREHEATING

- Heat to 1200°F and equalize
- Continue heating to 1550°F and equalize
- Complete heating to hardening temperature

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

**QUENCHING:** Performed as rapidly as possible without encouraging excessive movement or cracking.

### Typical quenching media includes:

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

\*Temper as soon as quenching temperature reaches 120°F-150°F

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

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

## TEMPERING

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

Choose the temperature to develop required hardness. ExELL H-13 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. Repeat for added tempers.

Typical tempering responses are:

Tempering Temperature	Harden 1870F HRC	Harden 1900F HRC
480F	52	53
1000F	53	54
1050F	51	53
1100F	46	49
1150F	42	46
1200F	35	37

**Note:** Use for approximate guideline only. Avoid tempering between 800°F-975°F to avoid risk of embrittlement.

## MECHANICAL PROPERTIES

### Typical Tensile Data vs. Hardness at Room Temperature

Hardness HRC	Tensile Strength (PSI)	Yield Strength (PSI)	%RA	%Elong
52	260,000	220,000	46	10
46	220,000	190,000	52	14

Common 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

## CAPABILITIES

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

Our steel making expertise is further enhanced by a long history of optimum forging and heat treatment practices. This allows us to develop special material characteristics of product uniformity, cleanliness, ability to polish, strength, toughness, hardenability, and more. All from ISO 9002 certified production facilities.

## QUALITY ASSURANCE

ELLWOOD Specialty Steel is committed to providing products and services that consistently meet and exceed quality and performance expectations. Our customer support and technical services help to ensure complete satisfaction.

As a flexible provider, we establish product programs to support industry or customer requirements. Our extensive stock program allows short mill lead times of custom forged products. Customized programs are available for specific customer needs.



## TOOL MAKING

For any additional information including welding, machining, grinding or EDM processing, please contact Ellwood Specialty Steel directly at: 800.932.2188.

This information is intended to provide general data on our products, 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 procedures 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. Please consult with ELLWOOD Specialty Steel for current information and/or capabilities.



# ELLWOOD

YOUR METALS PARTNER, FROM MELT TO DISTRIBUTION

**ISO 9001:2015 Certified**

ELLWOOD Specialty Steel | 499 Honeybee Lane | New Castle, PA 16105 | 800.932.2188

ESSsales@elwd  
ess.elwd.com

