



## 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 Ellwood Specialty steel reserves the right to make changes in practices which may render some information outdated or obsolete.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 15-5 PH* was developed by Ellwood Specialty Steel as a premium quality mold steel. ExELL 15-5 PH is a martensitic precipitation hardening stainless steel with certain advantages over conventional stainless mold steels. Some of these characteristics include:

- Superior corrosion resistance
- Simple heat treatment
- Uniformity of mechanical properties
- Easy to weld
- Excellent polishability
- Good dimensional stability
- Very good toughness

### TYPICAL ANALYSIS

|           |      |           |       |
|-----------|------|-----------|-------|
| <b>C</b>  | 0.04 | <b>Cr</b> | 15.20 |
| <b>Mn</b> | 0.70 | <b>Ni</b> | 4.80  |
| <b>Si</b> | 0.30 | <b>Cu</b> | 3.70  |
| <b>Mo</b> | 0.25 | <b>Cb</b> | 0.30  |

## APPLICATIONS

*ExELL 15-5 PH* is used in various tooling and engineered parts. Some typical applications include:

- Injection molds for various plastics and rubbers.
- Medical and food industry tooling
- Extrusion dies
- Compression molds
- Plastic processing equipment
- Manifold parts
- Glass molds
- Engineered components





**IMPROVED MANUFACTURING AND RELATED PERFORMANCE**

*ExELL 15-5 PH* is manufactured to the highest tooling quality standards for optimum service performance. From melting through final product testing, the finished product is a material with very good structure and mechanical property uniformity. Some manufacturing specifics include:

- VAR, Vacuum Arc Remelting
- Very precise chemistry control
- Heavy forging reduction
- Solution heat treating
- Precipitation (age) hardening if requested
- Complete manufacturing in facilities certified to ISO 9002

**PHYSICAL PROPERTIES**

**Physical Properties**

**Coefficient of Thermal Expansion, in/in/F**  
70 F.....0.000006  
400 F.....0.000006

**Modulus of Elasticity, psi**  
70 F.....29,000,000  
400 F.....27,700,000

**Thermal Conductivity, BTU in/ft<sup>2</sup> hr F**  
70 F.....130  
400 F.....155

**Specific heat, Btu/lb F**  
70 F.....0.11

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

**HEAT TREATMENT (General Recommendations)**

*ExELL 15-5 PH* is normally supplied in either the solution annealed condition or the solution annealed plus aged condition. However, the following thermal treat data may be useful if stress relieving, aging or re-solution annealing might be necessary.

**STRESS RELIEVING**

Stress relieving after aging is generally not performed because of the risk of undesired aging. Stress relieving will simultaneously age harden the material. Thus it is very useful to perform major machining in the solution annealed condition, then age the part as required. The aging treatment in this context will both precipitation harden and stress relieve the material.

**SOLUTION ANNEALING**

Solution annealing *ExELL 15-5 PH* should not be necessary. However, if aged material requires to be re-solution annealed treat as follows:  
Heat to 1900F, equalize, hold 30 minutes at temperature and air quench. Movement and distortion are likely.  
Resulting hardness will be ~30-33 HRC.



**AGE HARDENING**

If *ExELL 15-5 PH* was not supplied in a specific aged condition (prehardened), the material can be age hardened with an aging temperature generally between 925° and 1150°F. The aging temperature is typically selected to attain a desired hardness level.

Aging is performed by uniformly heating to the aging temperature, equalizing temperature from surface to center, holding 4 hours at temperature and air cooling. Slight shrinkage will occur after aging on the order of about 0.0005 to 0.0010 inches per inch.

| Condition | Aging Temp | Hardness (HRC) |
|-----------|------------|----------------|
| H925      | 925°F      | ~42-44         |
| H975      | 975°F      | ~39-41         |
| H1025     | 1025°F     | ~38-40         |
| H1150     | 1150°F     | ~33-35         |

Most aging is accomplished by using a 975°F age or higher. A 975°F aging treatment is used for a certain balance of hardness and toughness while higher temperature aging treatments will improve toughness and minimize over-aging if higher service temperatures are encountered.

**PROPERTY COMPARISONS**

| FEATURE              | P-20<br>302 HB | HOLDER<br>293 HB | 420F.m<br>320 HB | S-7<br>55 HRC | H-13<br>52 HRC | 420<br>50 HRC | 15-5 PH<br>40 HRC |
|----------------------|----------------|------------------|------------------|---------------|----------------|---------------|-------------------|
| Typical Hardness     |                |                  |                  |               |                |               |                   |
| Strength             | 2              | 1                | 2                | 9             | 7              | 6             | 4                 |
| Wear Resistance      | 1              | 1                | 1                | 7             | 6              | 5             | 4                 |
| Toughness            | 8              | 4                | 4                | 3             | 3              | 2             | 6                 |
| Texturing            | 6              | 1                | 1                | 5             | 5              | 5             | 8                 |
| Polishability        | 3              | 1                | 1                | 6             | 7              | 7             | 6                 |
| Corrosion Resistance | 1              | 1                | 4                | 1             | 1              | 6             | 8                 |
| Machinability*       | 4              | 6                | 5                | 6             | 6              | 6             | 3                 |
| Weldability          | 6              | 4                | 2                | 4             | 4              | 4             | 8                 |
| Nitriding Ability    | 6              | 5                | N/A              | 4             | 7              | N/A           | N/A               |
| Flame Hardening      | 7              | 7                | 2                | 2             | 2              | 2             | N/A               |

\*Machinability of P-20, Holder, 420F and 15-5PH is rated in the pre-hardened condition. S-7, H-13 and 420 are rated in the annealed condition. Overall ratings are 1-10 where 1 is the lowest rating.

**TOOLMAKING**

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

